MONTECITO RANCH

APPENDIX I

PRELIMINARY DRAINAGE STUDY

for the

DRAFT FINAL ENVIRONMENTAL IMPACT REPORT

SP01-001; VTM 5250RPL6; P04-045; P09-023; GPA 04-013; R04-022;
STP 08-019; ER 09-013; LOG NO. 01-09-013; SCH NO. 2002021132

APRIL 2010

APPENDIX I – PRELIMINARY DRAINAGE STUDY
INFORMATION FOR THE READER

This document consists of the Preliminary Drainage Study for the Montecito Ranch Project (Proposed Project or Project) and analyzes hydrology-related elements associated with construction and operation of the Project. Since circulation of the Draft Environmental Impact Report (EIR) of the Proposed Project and associated technical reports, there have been some changes in Project description.

The Preliminary Drainage Study that circulated with the Draft EIR indicated that a 10.6-acre future school site would be located off of future Montecito Ranch Road in the vicinity of the proposed parks and wastewater reclamation facility. At this time, this use is being eliminated from the Final EIR, and hence the Preliminary Drainage Study. Any graphic or text references to the future school site should be ignored by the reader. Upon Project approval, the future school site will be excluded from the Project and placed into open space. This alteration in the Project description would not change the conclusion with regard to the level of significance of impacts because removal of the future school site and placement into open space would be beneficial as the Proposed Project would result in fewer acres of impervious surface than analyzed in the report, and therefore, less runoff would occur.

The above-cited revision is now included as part of the public record and will be before the Board of Supervisors during their consideration of the Project.

STEVENS · CRESTO ENGINEERING, INC.

CEQA PRELIMINARY HYDROLOGY/DRAINAGE STUDY

MONTECITO RANCH

TM 5250 RPL4

COUNTY OF SAN DIEGO

Prepared for:
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January 12, 2004
Revised: January 15, 2008
SCE No. 02012.05

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SECTION 1

INTRODUCTION & PROJECT DESCRIPTION

Introduction

The CEQA Preliminary Hydrology/Drainage Study has been prepared to accompany the application to the County of San Diego for Montecito Ranch, Tentative Map No. 5250 RPL4. This study establishes the existing and proposed hydrologic conditions for the project. Hydrologic methods used for this report are consistent with the requirements of the County of San Diego as published in County of San Diego Hydrology Manual, dated June 2003. Section 3.3 provides the Project Drainage Summary (Executive Summary).

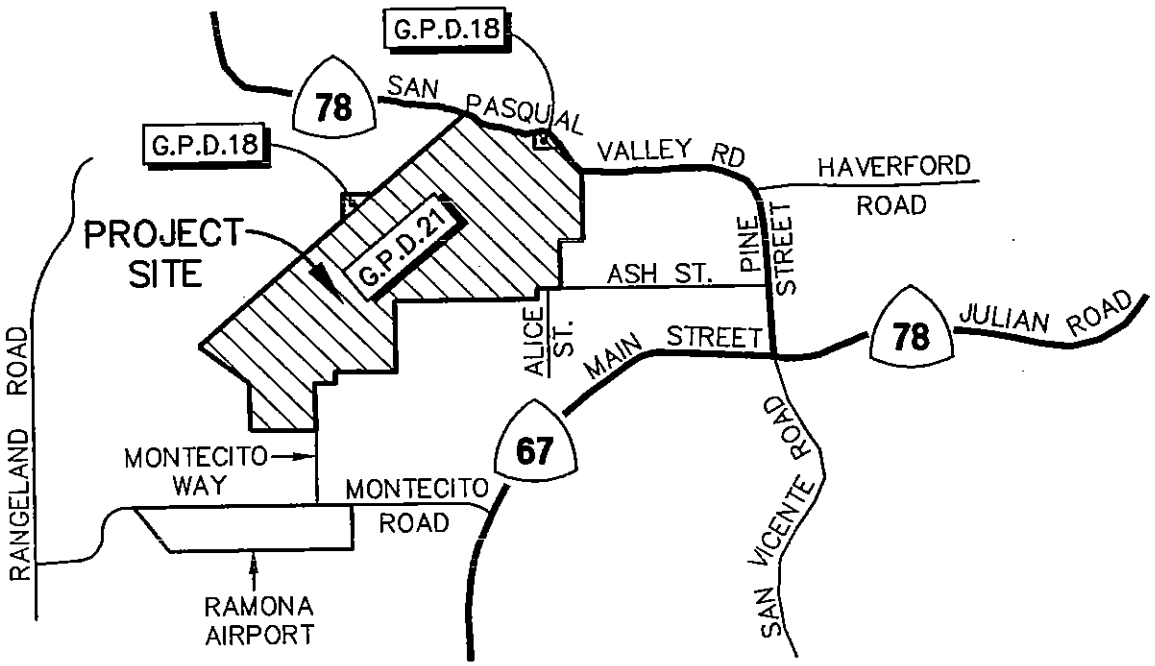
Project Description

The proposed Montecito Ranch subdivision is a rural residential community consisting of 417 single-family residential lots in the community of Ramona, County of San Diego, California (proposed Tract 5250). The project is bound by the Rancho Santa Maria line to the northwest, Highway 78 to the north, and the project is generally west of Pine Street and north of Cedar Street. The project contains 935 acres and is generally a portion of Sections 5,7,8,9, and 17, Township 13 South, Range 1 East. Immediate surrounding land uses consist of semi-rural and estate residential development to the north, east, and south, and the Lemurian Fellowship religious facility and orchards to the northwest. The Ramona Airport lies approximately 0.5 mile south of the project site. The proposed subdivision will contain 434 lots: 417 single-family residential lots (20,000 square-foot minimum in size), a school site, 13 lots which include uses for open space and drainage and infrastructure requirements, a park, a historic park site, and a wastewater facility. Park and school permanent post-construction BMPs shall be required and are to be determined by proposed developments/ developers at the building permit stage. The project will be developed in two map units.

2

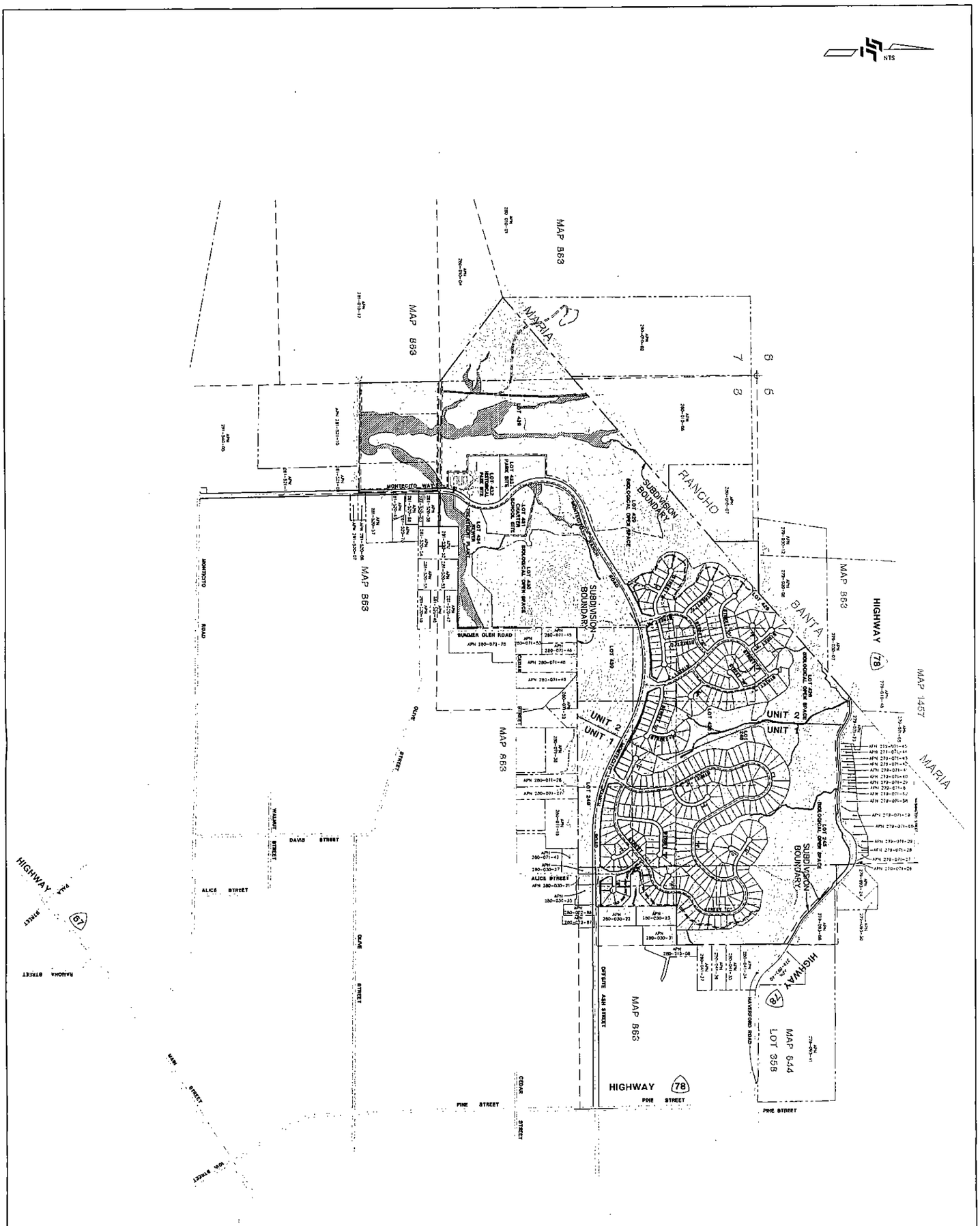
SECTION 2

VICINITY & SITE MAPS



VICINITY MAP

NOT TO SCALE



SITE MAP

MONTECITO RANCH

SAN DIEGO, CALIFORNIA

REVISIONS

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3

SECTION 3

TOPOGRAPHY AND LAND USE

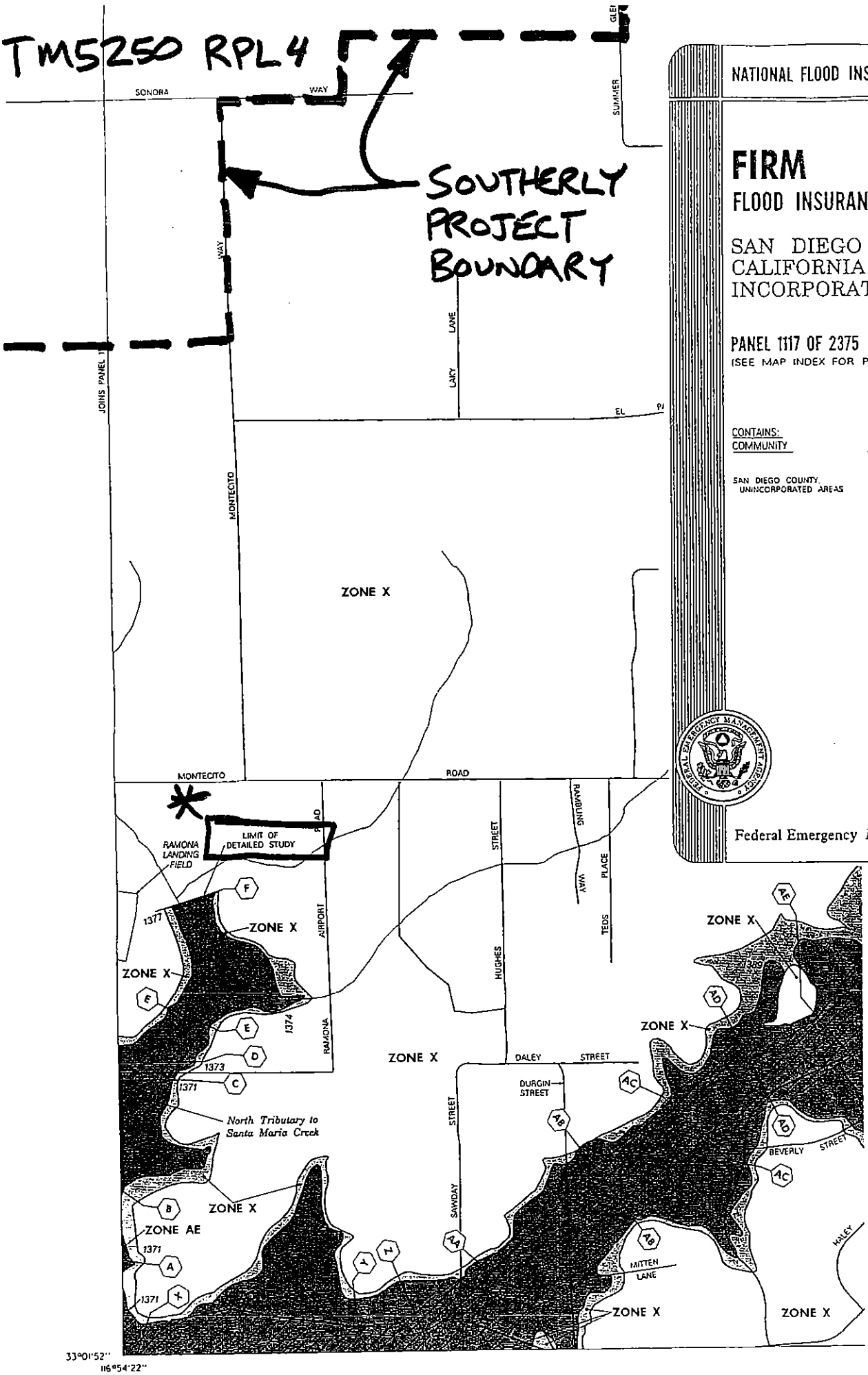
The project area is composed of a variety of topographic features including relatively steep slopes, rolling hills and relatively flat plains. The northern and eastern portions of the site generally slope to the north and east and are comprised of rolling hills with some relatively steep slopes and natural drainage channels that drain to Clevenger Canyon and Santa Ysabel Creek, a tributary of the San Dieguito River. The southern and western portions of the site are comprised of rolling hills to flat plain areas and generally slope to the south. This area drains to Santa Maria Creek, also a tributary of the San Dieguito River.

The property has historically been used for agricultural purposes. Approximately 250 to 300 acres of the site have been disturbed for farming. Previous agricultural use is an oat hay crop that failed due to the ongoing drought. An existing unoccupied ranch house is the only dwelling on-site and will be preserved with the proposed Montecito Historical Park. Other existing site features include rock outcroppings, isolated areas of "steep" slopes and various biological features subject to RPO are located on the site. The project site is located upstream to the north and east of mapped floodplain/floodway and is not impacted by floodplain/floodway limits on-site (see the following attached FEMA FIRM excerpts).

Montecito Ranch is located in the San Dieguito Watershed. The northeast 56 percent of the site is contained in hydrologic unit 905.5 Santa Ysabel and the remaining southwest 44 percent is contained in hydrologic unit 905.4 Santa Maria Valley. The north and east portion of the existing site drains northerly through Clevenger Canyon and is Tributary to Santa Ysabel Creek. The south and west portion of the site drains south to Santa Maria Creek. Off-site storm runoff conveyed through the site will continue to pass through the project and not be detained.

TM5250 RPL4

SOUTHERLY PROJECT BOUNDARY



33°01'52"
116°54'22"

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 1117 OF 2375
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
SAN DIEGO COUNTY, UNINCORPORATED AREAS	060284	1117	F

MAP NUMBER
06073C1117 F

EFFECTIVE DATE:
JUNE 19, 1997

Federal Emergency Management Agency

3.1 Existing Drainage

The Northern Drainage covers 56 percent of the existing site (north and east portions) and drains northerly through Clevenger Canyon and is tributary to Santa Ysabel Creek (North Regional Basin). The Southern Drainage covers the remaining 44 percent of the existing site (south and west portions) and drains to the south and is tributary to Santa Maria Creek (Sorth Regional Basin). The majority of the runoff discharged from the northern watershed originates primarily within the project boundary; while runoff discharged from the southern watershed originates both on-site at 44 percent and off-site at 56 percent.

Runoff from the Southern Drainage is conveyed southerly utilizing natural drainage paths and roadside ditches. Flows are conveyed southerly off-site through culvert crossings under existing roadways such as Montecito Way, Sonora Way and various dirt roads flows continue southerly to Santa Maria Creek.

Runoff from the Northern Drainage is conveyed to various concentration points on the north and east site boundaries. All of these areas ultimately drain north to Clevenger Canyon and Santa Ysabel Creek.

See Table 3.1 within Section 3.3 for a summary breakdown of peak flow rates for the existing condition.

3.2 Developed Drainage

The proposed project will not significantly alter drainage divides on the site. There will not be a substantial increase to the amount of impervious area. Of the 935 acre site, 592 acres will remain in open space, 277 acres will be developed for residential and community use. Public Streets cover the remaining 66 acres. The development of the site results in a minor increase in the composite runoff coefficient for the entire site, from C=0.35 to C=0.39.

The Southern Drainage peak flow rate will increase from 717 cfs in the existing condition to 751 cfs in the developed condition. The increase in peak flow rate of 34 cfs will be regulated through the use of a detention basin located within the Park Site. (See Section 6 for detention basin analysis.) Detention basins will serve to control peak flow rates and to improve water quality. Flow rates from the detention basins will be restricted such that peak rate of runoff from the developed project will be equal to or less than peak flow rates in the existing condition. Therefore, existing downstream drainage facilities will not see an increase in peak flow from the developed site.

The Northern Drainage area is broken into nine (9) separate basins, N100 through N900. As in the existing condition, all runoff flows to the north into Clevenger Canyon and Santa Ysabel Creek. The peak runoff rates from basins N100 and N600/700 will increase from the existing condition and will be regulated by using detention basins. (See Section 6 for detention basin analysis.) Peak flow rates from the remaining northerly basins will be equal or have levels of reduction which are insignificant (Typically, the reductions now are all less than one half of one percent (<0.5%) with one location at 0.8%) and thus will not require detention basins. Therefore, existing downstream drainage facilities will not see an increase in peak flow from the developed site.

See Table 3.2 within Section 3.3 for a summary breakdown of peak flow rates for the developed condition.

100-Year Inundation

Proposed pads and structures, adjacent to existing streams and gullies, will be free of inundation during the 100-year storm event due to the relatively large amount of relief associated with the terrain and elevated pad heights. Approximate inundation widths are shown on the Tentative Map for basins in excess of twenty five acres. Due to the relief and flow rates, inundation is minor near subdivision outlets and depicted as a single line until inundation depth and ravine geometry are sufficient to depict; otherwise the width of inundation is in-significant.

3.3 Project Drainage Summary

Hydrology Section 5 provides rational method calculations identifying existing and proposed runoff rates per San Diego County criteria. No diversion is proposed. No adverse impacts are generated from the hydraulic design of this subdivision. Detention basins are employed which detain runoff. Flow controls are specified to assure flow rates discharging to existing drainage courses are at or below existing rates. Energy dissipation is employed to reduce velocities prior to discharge to existing drainage courses. Meeting with County Staff has yielded a threshold of 30% for allowable reduction in flow rate without impact to downstream wetlands or riparian habitats. Detention design, release rate and preliminary routing, Section 6, meets and exceeds the project criteria for limiting runoff rates to existing levels, and was prepared using criteria set forth within the San Diego County Drainage Design Manual (May 2005). Release rates and preliminary routing and storage calculations follow County criteria. This report demonstrates the summation of the detention basin storage capacity is in excess of the maximum event capture volume (detention for storm water quality) and presents calculations to regulate proposed runoff to existing levels during the 100-year storm event by detaining the difference between existing and proposed flow rates for each proposed drainage basin that exceeds the existing flow rate when developed. Tables 3.1 and 3.2 summarize the hydrology results.

Table 3.1
Existing Condition Hydrologic Results

Table 3.1 below summarizes the existing condition drainage areas and flows from the Montecito Ranch site. Calculations are based on the Rational Method and the criteria set forth in the County of San Diego standard cited below. Basin delineations are graphically depicted on the Existing Drainage Basins Map located in the Hydrology section of this report.

Basin	Drainage Area (Acres)	100-Year Peak Flow Rate (CFS)	CFS/Acre
S100	927.0	711.6	0.77
N100	295.0	347.4	1.18
N200	24.2	39.8	1.64
N300	22.3	38.1	1.71

N400	78.7	108.3	1.37
N500	42.1	61.7	1.47
N600/700	20.79	37.7	0.60
N800	58.0	82.4	1.42
N900	4.5	9.1	2.04

Table 3.2
Developed Condition Hydrologic Results

Table 3.2 below summarizes the developed condition hydrology. Basin delineations are graphically depicted on the Proposed Drainage Basins Map located in the Hydrology Section 5 of this report { (+) indicates increased value from existing conditions, (-) indicates decreased value from existing conditions}. Calculations show a slight increase in peak runoff from selected basins on the site, which will be regulated by the use of detention basins. See Section 6 for detention basin analysis and preliminary detention sizing.

Basin	Drainage Area (Acres)	100-Year Peak Flow Rate (cfs)	CFS/Acre	Peak Flow Difference from existing (cfs)	Percent Change in Peak Runoff **UN-DETAINED****	Percent Change in Peak Runoff **DETAINED**
S100	926.9	752.2	0.81	+40.6	+5.7%	0.0%
N100	287.7	458.8	1.59	+111.4	+32.1%	0.0%
N200	26.6	39.8	1.50	0.0	0.0%	0.0%
N300	24.4	38.3	1.57	+0.2	+0.5%	N/A
N400	79.9	108.1	1.35	-0.2	–0.2%	N/A
N500	29.8	61.2	2.05	-0.5	-0.8%	N/A
N600/700	29.2	49.2	1.68	+11.5	+30.5%	0.0%
N800	63.8	82.7	1.30	+0.3	+0.4%	N/A
N900	4.2	9.1	1.17	0.0	0.0%	N/A

**Increase in peak flow rates mitigated through detention basins, see Section 6 for calculations.

3.4 Declaration of Responsible Charge

I hereby declare that I am the Engineer of Work for this project, that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with current standards.

I understand that the check of project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as Engineer of Work, of my responsibilities for project design.

Mark E. Stevens
R.C.E. 35502

01/18/08
Date

REGISTERED PROFESSIONAL ENGINEER
MARK E. STEVENS
C 35502
EXP. 9-30-07
CIVIL
STATE OF CALIFORNIA

4

SECTION 4

METHODOLOGY & MODEL DEVELOPMENT

Methodology and Model Development

The hydrologic method used in determining runoff rates is the Rational Method and Modified Rational Method as prescribed per the County of San Diego Department of Public Works Flood Control Division Hydrology Manual, dated June 2003. Design storm analyzed for this report is the 100-year frequency storm as follows:

1) Design for areas over 1 square mile will be based on the 100-year frequency storm.

2) For areas under 1 square mile –

   a. The storm drain system shall be designed so that the combination of storm drain system and overflow both inside and outside the right of way will be able to carry the 100-year frequency storm without damage to adjacent existing buildings or potential building sites.

   b. The storm drain system shall be designed so that the combination of storm drain system capacity and allowable street overflow will be able to carry the 50-year frequency storm without damaging adjacent property.

   c. Where a storm drain is required, as a minimum, the storm drain shall be designed to carry the 10-year frequency storm.

3) Sump areas are to be designed for a sump capacity or outfall of a 100-year frequency storm.

Modified Rational Method Hydrologic Analysis

Design Storm – 100 year return interval

Land Use – Single Family Residential in Developed areas

Soil Type – Hydrologic Soil Group D is assumed for all areas. Group D soils have very slow infiltration rates when thoroughly wetted. Group D soils have a very slow rate of water transmission due to: clay soils with a high swelling potential, soils with a high permanent water table, clay pan layer at or near the surface, and shallow soils over nearly impervious materials such as rock.

Runoff Coefficient – In accordance with the County of San Diego standards, single-family residential areas were designated a runoff coefficient of 0.45 based on 1.7 DU/A, while natural areas were designated a runoff coefficient of 0.35. The school site located within the subdivision was designated a runoff coefficient of 0.79. Isolated sub-basins that cover roadway areas were designated a runoff coefficient of 0.80.

Method of Analysis – The Modified Rational Method is the most widely used hydrologic model for estimating peak runoff rates. Applied to small urban and semi-urban areas less than 1.0 square miles, the Rational Method relates rainfall intensity, runoff coefficients and drainage area to peak runoff rates. This relationship is expressed by the equation:

Q = C I A, where:

Q = The peak runoff rate in cubic feet per second at the point of analysis.

C = A runoff coefficient representing the area – averaged ratio of runoff to rainfall intensity.

I = The time-averaged rainfall intensity in inches per hour corresponding to the time of concentration.

A = The drainage basin area in acres.

To perform a node-link study, the total watershed area is divided into subareas which discharge at designated nodes.

The procedure for the subarea summation model is as follows:

1) Subdivide the watershed into an initial subarea and subsequent subareas, which are generally less than 10 acres in size. Assign upstream and downstream node numbers at each subarea.

2) Estimate an initial time of concentration (T_c) by using the appropriate nomograph or overland flow velocity estimation.

3) Using the initial T_c, determine the corresponding values of I. Then Q = C I A.

4) Using Q, estimate the travel time between this node and the next by Manning's equation as applied to the particular channel or conduit linking the two nodes. Then repeat the calculation for Q based on the revised intensity (I), which will be lower for each iteration as the T_c extends along the flow path.

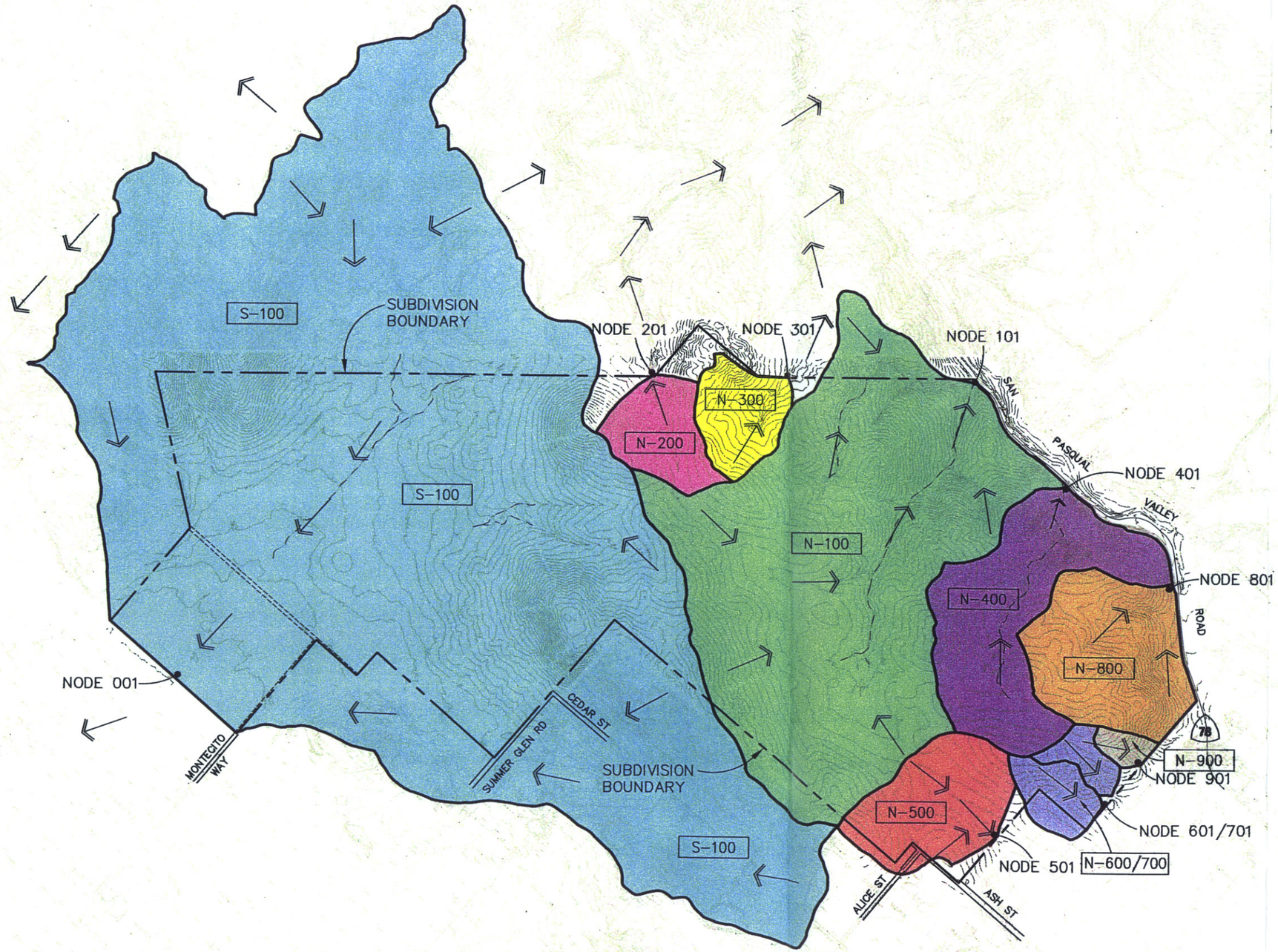
The nodes are joined together by links, which may be street gutter flows, drainage swales, drainage ditches, pipes, or channels.

A solution for hydrologic calculations is provided for the existing and developed conditions in Section 5.

5

SECTION 5

HYDROLOGY CALCULATIONS



SCALE: 1"=1200'

LEGEND

- DRAINAGE BASIN BOUNDARY
- N-200 DRAINAGE BASIN I.D.
- DIRECTION OF FLOW

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MONTECITO RANCH
EXISTING DRAINAGE BASINS
COUNTY OF SAN DIEGO TRACT 5250

X:\DWG\Job\02012\DRAINAGE\EX-BASIN 11x17.dwg 1-12-04 10:11:18 am EST

Montecito Ranch TM 5250 - EXISTING CONDITIONS

Time of Concentration [1] (County of San Diego Appendices)

RUN: 6/30/06 9:15 AM

COUNTY OF SAN DIEGO PRECIPITATION (APP. XI)= 3.3 in/hr

DESIGN POINT	SUB-BASIN DATA: DRAIN BASIN	AREA ac.	C	NATURAL WATERSHED TIME (App. X-A): Length ft.	H ft.	T(c) min	TRAVEL TIME T(t) (App. X-D[1] / Pipe V): Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	FINAL T(c) min.	REMARKS
BASIN S-100													
001		927.0	0.35	9032.0	236.0	42.3						42.3	
BASIN N-100													
101		295.0	0.35	5357.0	464.0	21.8						21.8	
BASIN N-200													
201		24.2	0.35	1640.0	136.0	13.0						13.0	
BASIN N-300													
301		22.3	0.35	1270.0	90.0	12.2						12.2	
BASIN N-400													
401		78.7	0.35	3480.0	340.0	17.1						17.1	
BASIN N-500													
501		42.1	0.35	1800.0	73.0	15.5						15.5	
BASIN N-600/700													
601/7701		20.8	0.35	1070.0	95.0	11.2						11.2	
BASIN N-800													
801		58.0	0.35	2207.0	108.0	16.3						16.3	
BASIN N-900													
901		4.5	0.35	770.0	149.0	9.4						9.4	

Montecito Ranch TM 5250 - EXISTING CONDITIONS

Runoff Calculations

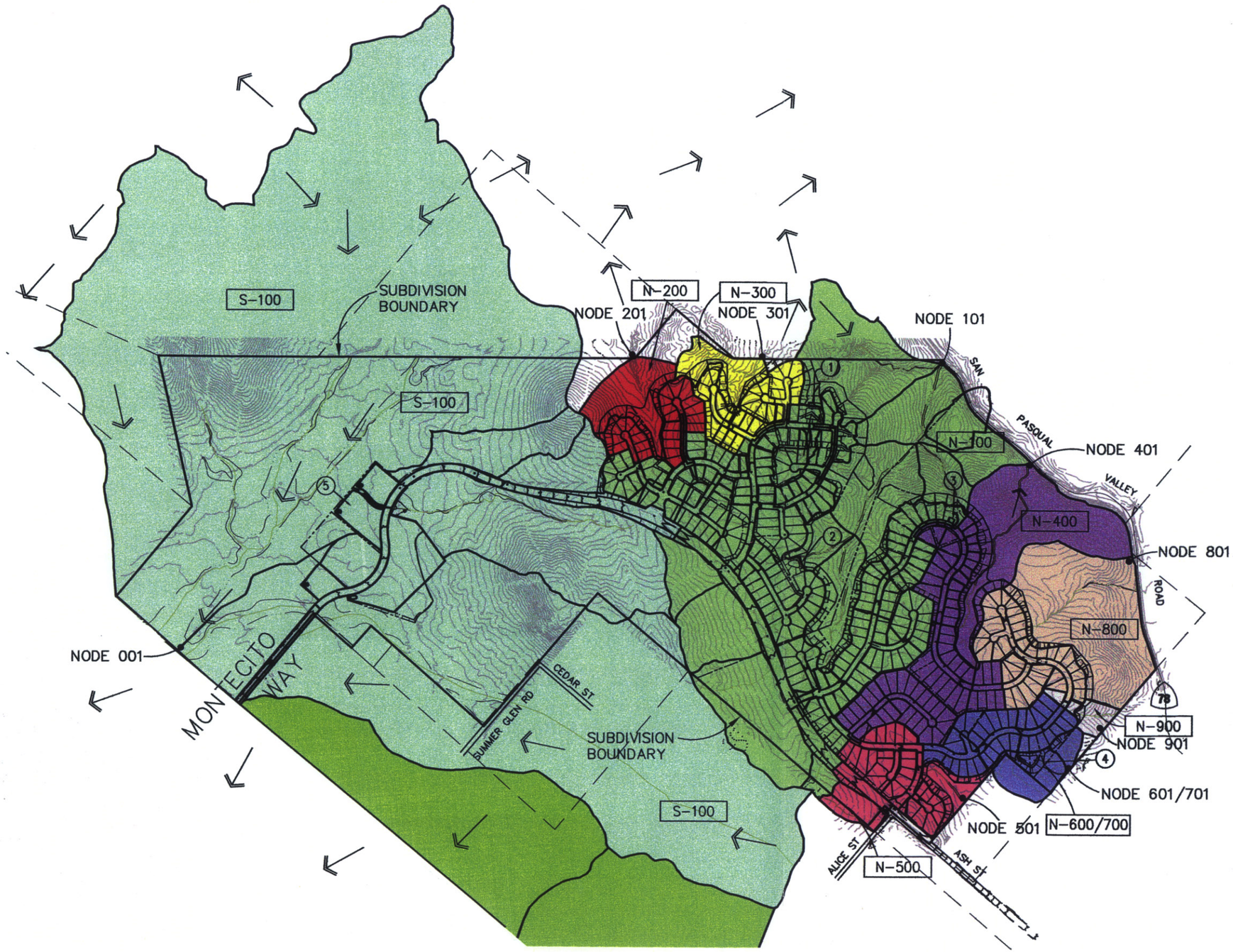
(Modified Rational Method Procedure)
Design Storm 100 Year

[2] (County of San Diego Appendix XI) Intensity-Duration Design Chart

RUN: 6/30/06 9:15 AM

COUNTY OF SAN DIEGO PRECIPITATION (APP. XI)= 3.3 in/hr

BASIN INFORMATON				DIRECT RUNOFF								
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I [2] in/hr	Q cfs					REMARKS
BASIN S-100												
		927.0	0.35	42.3	324.45	2.19	711.6					Modified Rational Method
BASIN N-100												
		295.0	0.35	21.8	103.26	3.36	347.4					
BASIN N-200												
		24.2	0.35	13.0	8.47	4.70	39.8					
BASIN N-300												
		22.3	0.35	12.2	7.79	4.89	38.1					
BASIN N-400												
		78.7	0.35	17.1	27.54	3.93	108.3					
BASIN N-500												
		42.1	0.35	15.5	14.73	4.19	61.7					
BASIN N-600/700												
		20.8	0.35	11.2	7.28	5.18	37.7					
BASIN N-800												
		58.0	0.35	16.3	20.30	4.06	82.4					
BASIN N-900												
		4.5	0.35	9.4	1.58	5.81	9.1					



SCALE: 1"=1200'

LEGEND

- DRAINAGE BASIN BOUNDARY
- N-200 — DRAINAGE BASIN I.D.
- DIRECTION OF FLOW
- (1) DETENTION BASIN N-100-38
- (2) DETENTION BASIN N-100-24
- (3) DETENTION BASIN N-100-13
- (4) DETENTION BASIN N-600/700-6
- (5) DETENTION BASIN S-100

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MONTECITO RANCH
DEVELOPED ONSITE DRAINAGE BASINS
COUNTY OF SAN DIEGO TRACT 5250

Montecito Ranch TM 5250 - DEVELOPED CONDITION

Time of Concentration

(1) (County of San Diego Appendices)

COUNTY OF SAN DIEGO PRECIPITATION (APP. XI)= 3.3 in/hr

DESIGN POINT	SUB-BASIN DATA: DRAIN BASIN	AREA ac.	C	NATURAL WATERSHED TIME (App. X-A): Length ft.	H ft.	T(c) min	TRAVEL TIME T(t) (App. X-D(1) / Pipe V): Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	FINAL T(c) min.	REMARKS
BASIN S-100													
001		926.9	0.37	9032.0	236.0	42.3						42.3	
BASIN N-100													
101		287.7	0.41									23.1	
BASIN N-200													
201		26.6	0.39									17.8	
BASIN N-300													
301		24.4	0.39									16.5	
BASIN N-400													
401		79.9	0.39									20.8	
BASIN N-500													
501		29.8	0.45									13.6	
BASIN N-600/700													
601/701		29.2	0.45									18.5	
BASIN N-800													
801		63.8	0.37									20.5	
BASIN N-900													
901		4.2	0.35	447.0	93.0	8.5						8.5	

Montecito Ranch TM 5250 - DEVELOPED CONDITION

Runoff Calculations

(Modified Rational Method Procedure)
Design Storm 100 Year

(2) (County of San Diego Appendix XI) Intensity-Duration Design Chart

COUNTY OF SAN DIEGO PRECIPITATION (APP. XI)= 3.3 in/hr

BASIN INFORMATON				RUNOFF								
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I (2) in/hr	Q_{100} cfs					REMARKS
BASIN S-100												
		926.9	0.37	42.3	342.96	2.19	752.2					MRM
BASIN N-100												
		287.7	0.41	17.4		3.89	458.8					MRM
BASIN N-200												
		26.6	0.39	17.8	10.37	3.84	39.8					
BASIN N-300												
		24.4	0.39	16.5	9.52	4.03	38.3					
BASIN N-400												
		79.9	0.39	20.8	31.16	3.47	108.1					
BASIN N-500												
		29.8	0.45	13.6	13.41	4.56	61.2					
BASIN N-600/700												
		29.2	0.45	18.5	13.14	3.74	49.2					
BASIN N-800												
		63.8	0.37	20.5	23.61	3.50	82.7					
BASIN N-900												
		4.2	0.35	8.5	1.47	6.19	9.1					

FLOOD AND DRAINAGE MANAGEMENT REPORT

FOR

THE RAMONA AREA

(SPECIAL DRAINAGE AREA #8)

COUNTY OF SAN DIEGO FLOOD CONTROL DISTRICT

JUNE 1992

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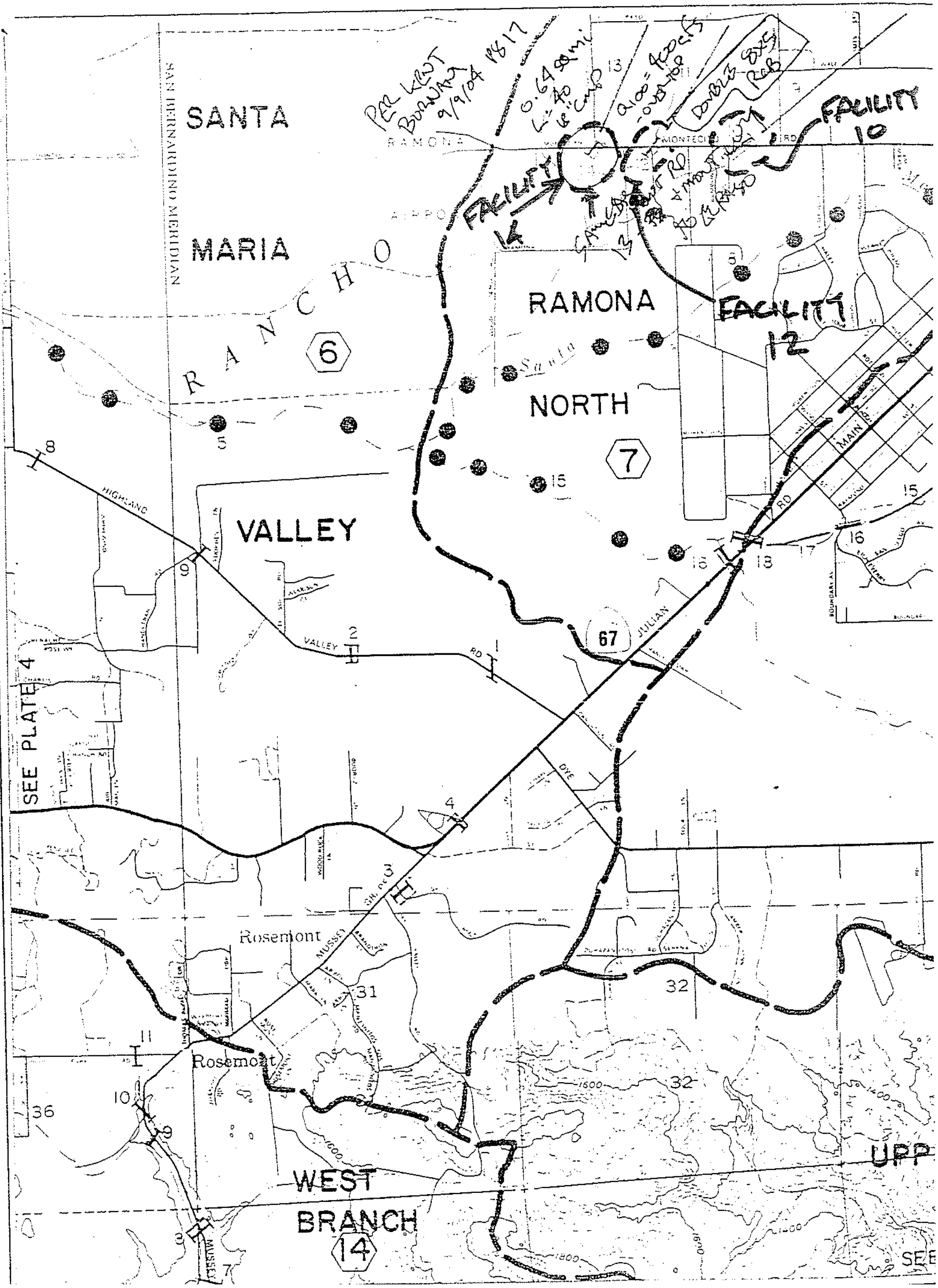
San Diego, California 92121

Albuquerque • Santa Fe • San Diego


SAN BERNARDINO MERIDIAN
SANTA
MARIA
RANCHO
6
RAMONA
NORTH
7
VALLEY
HIGHLAND
VALLEY
RD
JULIAN
67
MAIN
DYE
SEE PLATE 4
Rosemont
Rosemont
WEST
BRANCH
14
UPP
FACILITY 14
FACILITY 10
FACILITY 12

The recommended improvements shown in this table are for the purpose of providing a basic design for cost estimating. Environmental review and final design will be necessary before any improvements can be constructed.

SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

Basin No.	Facility No.	Plate No.	Location	Drainage Area (SQ MI)	Length (FT)	Existing Conditions	Capacity CFS Existing	Capacity CFS Required 1992 50 YR	Capacity CFS Required 1992 100 YR	Associated Problems	Recommended Improvements	Installation Cost (Dollars)	Priority
7	6	5	Between Facility 5 & Montecito Rd.	30.00	2,000	Santa Maria Ck., Flood Plain Mapped			15,600	Flooding Of Future Development	None	$3,800	3
7	7	5	Montecito Rd. Crossing of Santa Maria Ck.	30.00	130	3-Span Bridge 130' Long	10,000		15,600	Overtops Bridge	Add 4 - 12' x 10' RCB	$94,500	4
7	8	5	Santa Maria Ck., Downstream from Montecito Rd.	31.50	12,000	Natural Ck. Bed, Flood Plain Mapped			15,600	Flooding Of Existing And Future Development	None	$22,700	2
7	9	5	From Montecito Ave., 5,000 Ft. West of 7	0.50	4,900	Natural Drainage			390	Flooding Of Existing And Future Development	Earth Ch. b = 10' d = 4'	$392,200	2
7	10	5	On Montecito Rd., Downstream of Facility 9.	0.50	40	42" x 29" CMPA	52		390 => 1.2 cfs/Ac	Overtops Road	Add Double 8' x 5' RCB	$31,200	4
7	11	5	From Montecito Rd. to El Paso St.	0.30	2,500	Natural Drainage			200	Flooding Of Future Development	Earth Ch. b = 8' d = 3'	$146,800	3
7	12	5	On Montecito Rd., Downstream of Facility 11.	0.30	40	49" x 33" CMPA	78		200 => 1.0 cfs/Ac	Overtops Road	Add Double 6' x 4' RCB	$23,100	4

COUNTY OF SAN DIEGO
community services agency
department of sanitation & flood control

COMPREHENSIVE PLAN
FOR
FLOOD CONTROL and DRAINAGE

ZONE 1
SAN DIEGO COUNTY
FLOOD CONTROL DISTRICT

JULY 1976

KOEBIG, INC. ENGINEERING·ARCHITECTURE·PLANNING

The recommended improvements shown in this table are for the purpose of providing a basic design for cost estimating. Environmental review and final design will be necessary before any improvements can be constructed.

SUMMARY OF EXISTING CONDITIONS AND RECOMMENDED IMPROVEMENTS

Basin No.	Facility No.	Plate No.	Location	Drainage Area (SQ MI)	Length (FT)	Existing Conditions	Capacity CFS Existing	Capacity CFS Required 1992 50 YR	Capacity CFS Required 1992 100 YR	Associated Problems	Recommended Improvements	Installation Cost (Dollars)	Priority
7	13	5	From Junction of Montecito Rd. & Montecito Way to El Paso St.	0.64	2,300	Natural Drainage			400	Flooding Of Future Development	Earth Ch. b = 8' d = 4'	$168,900	3
7	14	5	Junction of Montecito Rd. & Montecito Way	0.64	40	18" CMP			400 ⇒1.0 cfs/ac	Overtops Road	Double 8' x 5' RCB	$31,200	4
7	15	5	Between Hwy. 67 & Santa Maria Creek	9.00	5,300	Natural Drainage, Flood Plain Mapped			5,800	Flooding Of Possible Future Development	None	$10,000	3
7	16	5	Main St., S.W. of Ramona	3.20	75	2 - 8' x 6' RCB	1,040		1,650	Overtops Road	Add 10' x 6' RCB	$45,300	4
7	17	2	Crosses Poplar St. East of Pine St.	—	—	48" Pipe	—		—	Adequate	None	$18,320	5
7	18	2	Crosses Pamo Rd. South of Pile St.	—	—	8' x 2' RCB	—		—	Adequate	None	$24,160	5
7	19	5	Eleventh St. at "D" St. Northerly.	0.12	1,285	54" RCP	81		80	Adequate	None	$257,000	5
7	20	5	Seventh St. Between "B" St. and "D" St.	0.10	907	60" CIP	189		187	Adequate	None	$181,400	5

SECTION 6

DETENTION BASIN ANALYSIS

Development will increase peak discharge during the 100-year storm event within Basins S100, N100, and N600/700. Resultantly, these regional basins contain detention facilities to limit runoff to existing levels.

Considering this study is a "CEQA Preliminary Hydrology/Drainage Study" in support of the Tentative Map at a discressionary level, final detention calculations are not appropriate at this time. Resultantly, final detention basin routing will occur at final engineering, this study provides preliminary calculations for required detention based upon County criteria (see "CRITERIA" below). Section 6.2 provides detailed calculation, utilizing preliminary hydrograph routing, for each detention basin designed for the project. Section 6.1 checks the detention capacity for satisfaction of water quality objectives utilizing the ASCE maximum capture approach and compares the maximum capture volume to capacity provided by the project design.

CRITERIA: utilizing methodology presented within, "San Diego County Drainage Design Manual; May 2005" and "Stormwater Management in small watersheds – Detention Storage to Reduce Peak Flows dated: September 1993 & April 1996":

1. **LIMIT RUNOFF TO EXISTING LEVELS**
2. **GENERATE RATIONAL METHOD PEAK FLOW**
3. **GENERATE INFLOW HYDROGRAPH UTILIZING "RATHYDRO"**
4. **PRELIMINARY DETENTION BASIN ROUTING FOR CALCULATING STORAGE VOLUME REQUIRED AND VERIFICATION OF STORAGE VOLUME PROVIDED**

1. LIMIT RUNOFF TO EXISTING LEVELS: proposed release rates from detention facilities have been attenuated and balanced (reduced) by limiting outlet flows from detention basins, to balance overall post construction runoff flow rates, to existing levels; as necessary to meet exiting flow rates for each regional basin S100, N100, AND N600/700 (see Section 3, Table 3.2). Therefore, existing downstream drainage facilities will not see an increase in peak flow from the developed site.

2. GENERATE RATIONAL METHOD PEAK FLOW (see Section 4 and 5)

3. GENERATE INFLOW HYDROGRAPH UTILIZING "RATHYDRO": the "Rational Method Hydrograph Program" by Rick Engineering Company, supplied by the County of San Diego, has been utilized to determine the developed "inflow" hydrograph, utilizing parameters at the outfall points for each regional basin S100, N100, AND N600/700 (see Section 3). The parameters for the inflow hydrograph are the Rational Method weighted runoff coefficient, time of concentration, peak flow, six hour precipitation and overall basing area; all calculated for the developed condition.

4. PRELIMINARY DETENTION BASIN ROUTING FOR CALCULATING STORAGE VOLUME REQUIRED: overall project detention requirements are determined following the methods outlined in the County design manuals referenced above; criteria. Overall detention storage

is developed using "Single Hydrograph Procedures" outlined within, "Stormwater Management in small watersheds – Detention Storage to Reduce Peak Flows dated September 1993 & April 1996." Utilizing these methods for the Regional Basins (see Section 3), the inflow hydrograph (Item 3 above) is plotted against the outflow hydrograph and the area between the two hydrographs is calculated; overall detention requirement. Release rate results will be on the shown on the Final Map to assure runoff will not exceed the existing levels. Runoff generated from open space areas (run-on) to the project will not be detained and will pass through the project in natural open channels; as is the existing condition.

6.1 ASCE- Storm Water Quality Detention Verification

As verification of Storm Water Quality objectives, detention basin sizing for the project has been checked against the maximum capture of urban runoff per ASCE Manual of Practice No. 87, (1998); Per the County of San Diego Ordinance No. 9426 (W.S.), Section 5.2.3.1. Computations for the maximized capture urban runoff volumes are shown in Section 3.2 of the Storm Water Mitigation Plan, T.M. RPL4, Montecito Ranch. An excerpt from Section 3.2 follows:

Table 6.1
(From Storm Water Management Plan)

A. Imperviousness – Composite

Developed Pads	~	243.9 Ac	@	20% imp	(73.0%)	=	0.1461
Community Park	~	8.3 Ac	@	10% imp	(2.5%)	=	0.0025
Charter School	~	12.8 Ac	@	80% imp	(3.8%)	=	0.0307
Community Site	~	2.5 Ac	@	85% imp	(0.7%)	=	0.0064
Developed Roads	~	39.2 Ac on-site	@	95% imp	(11.7%)	=	0.1115
Montecito Ranch Road	=	27.2 Ac	@	90% imp	(8.1%)	=	0.0733

Disturbed Ground Sub Total 333.9 Ac

I=0.3705

B. Max. Capture Urban Runoff Volume (Total Site Requirement)

Refer to the ASCE manual at the end of this section for definitions of variables and equations.

1. $C = 0.858\,(0.3705)^3 - 0.78\,(0.3705)^2 + 0.774\,(0.3705) + 0.04$

   $C = 0.2633$

2. $P_o = (a \bullet c)P_6$ $\quad a = 1.582$ (24 hr drain time)

   $P_6 = 0.83$ in

   $P_o = (1.582)(0.2633)(0.83) = 0.3458$ in

3. $Vol = P_{o\,(in)} (0.0833 \frac{Ac \bullet Ft}{Ac \bullet In}) A$

$Vol = 0.3458\ (0.0833)(333.9) = 9.62\ Ac - Ft$

C. Total Project Detention Requirements

Vol = 9.6 Ac • Ft required

Vol = 18.6 Ac • Ft provided

Factor Of Safety (F.O.S.) = 1.9

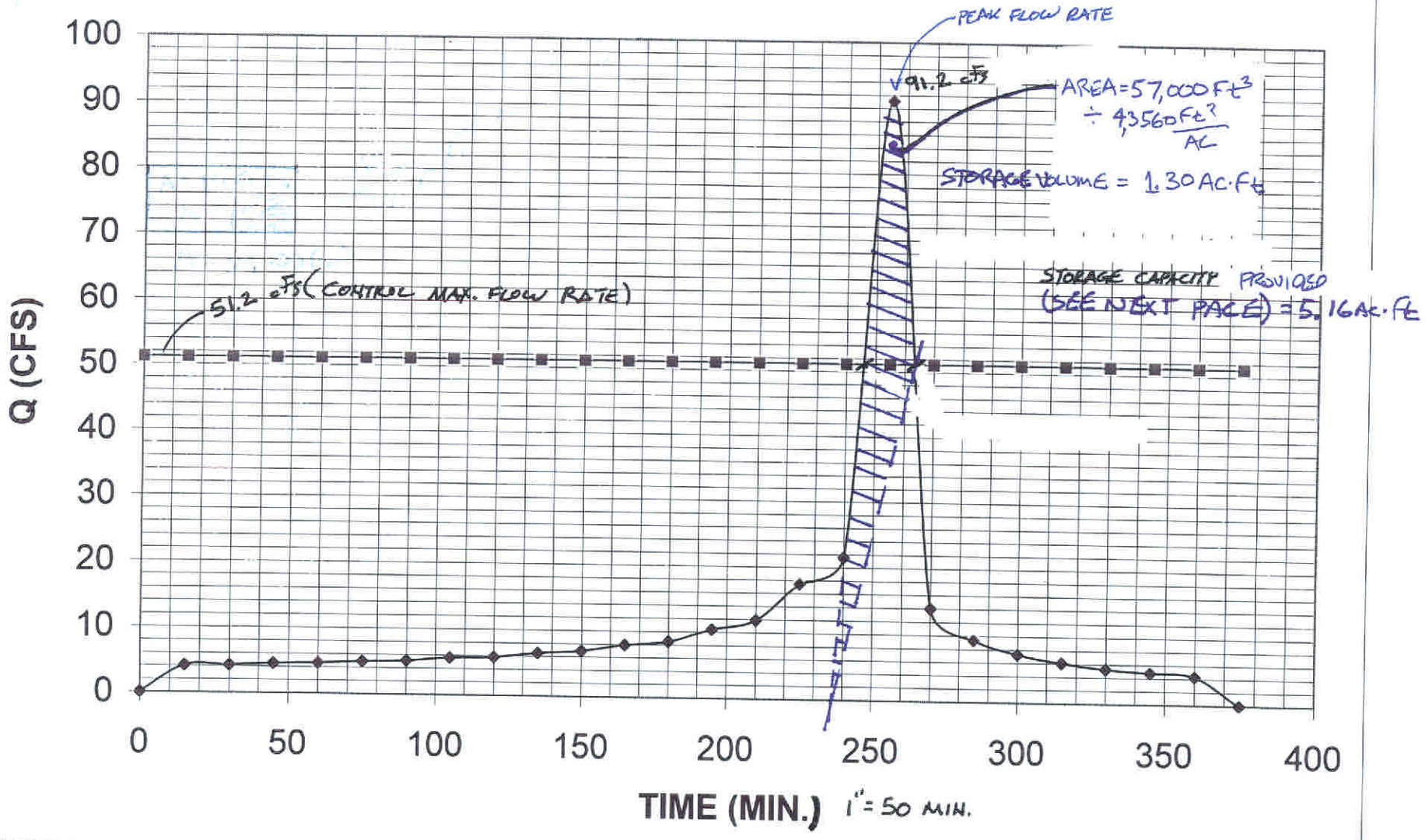
SECTION 6.1

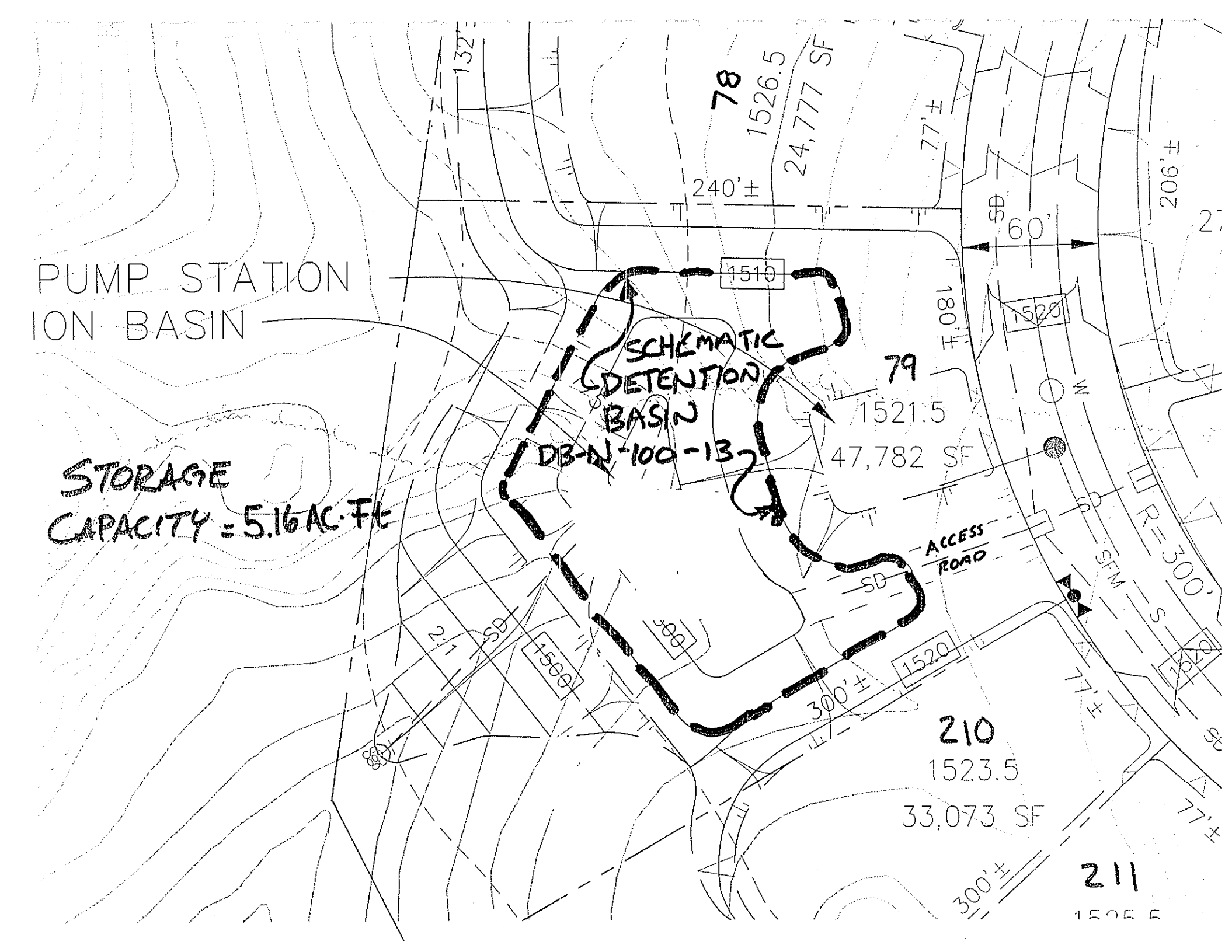
Basin N100

Proposed flow rate for Basin N-100 at Node 101 is approximately 111 cfs higher than the existing flow rate during the 100-year storm event. Proposed release rates from detention facilities have been arithmetically regulated (reduced) as necessary to meet exiting flow rates at each node. This provides a conservative approach, as the time of concentration after leaving the detention facilities will be increased, further reducing the flow rate at the node points. As a check of preliminary detention volumes, the "Rational Method Hydrograph Program" by Rick Engineering Company, supplied by the County of San Diego, has been utilized to determine the inflow hydrograph utilizing parameters at the inlet of each detention facility. Utilizing this hydrograph in combination with the reduced release rate confirms the minimum storage capacity for each detention basin to be less than the volume of storage provided.

The release rate from detention Basins DB N-100-13, DB N-100-24, and DB N-100-38, in proposed Basin N100, have been reduced by 37 cfs (see Section 5 "Developed On-site Drainage Basins" exhibit for detention basin location and designations). The difference in the peak flow rate and control flow rate for each detention basin over the given time interval, (See flowing graphs in this section), is the minimum storage volume necessary to control the peak flow rate at Node 101.

D.B. N-100-13


PEAK FLOW RATE
91.2 cfs
AREA = 57,000 Ft³ ÷ 43560 Ft²/AC
STORAGE VOLUME = 1.30 AC·Ft
STORAGE CAPACITY PROVIDED (SEE NEXT PAGE) = 5.16 AC·Ft
51.2 cfs (CONTROL MAX. FLOW RATE)
Q (CFS)
100
90
80
70
60
50
40
30
20
10
0
0
50
100
150
200
250
300
350
400
TIME (MIN.)
1" = 50 MIN.

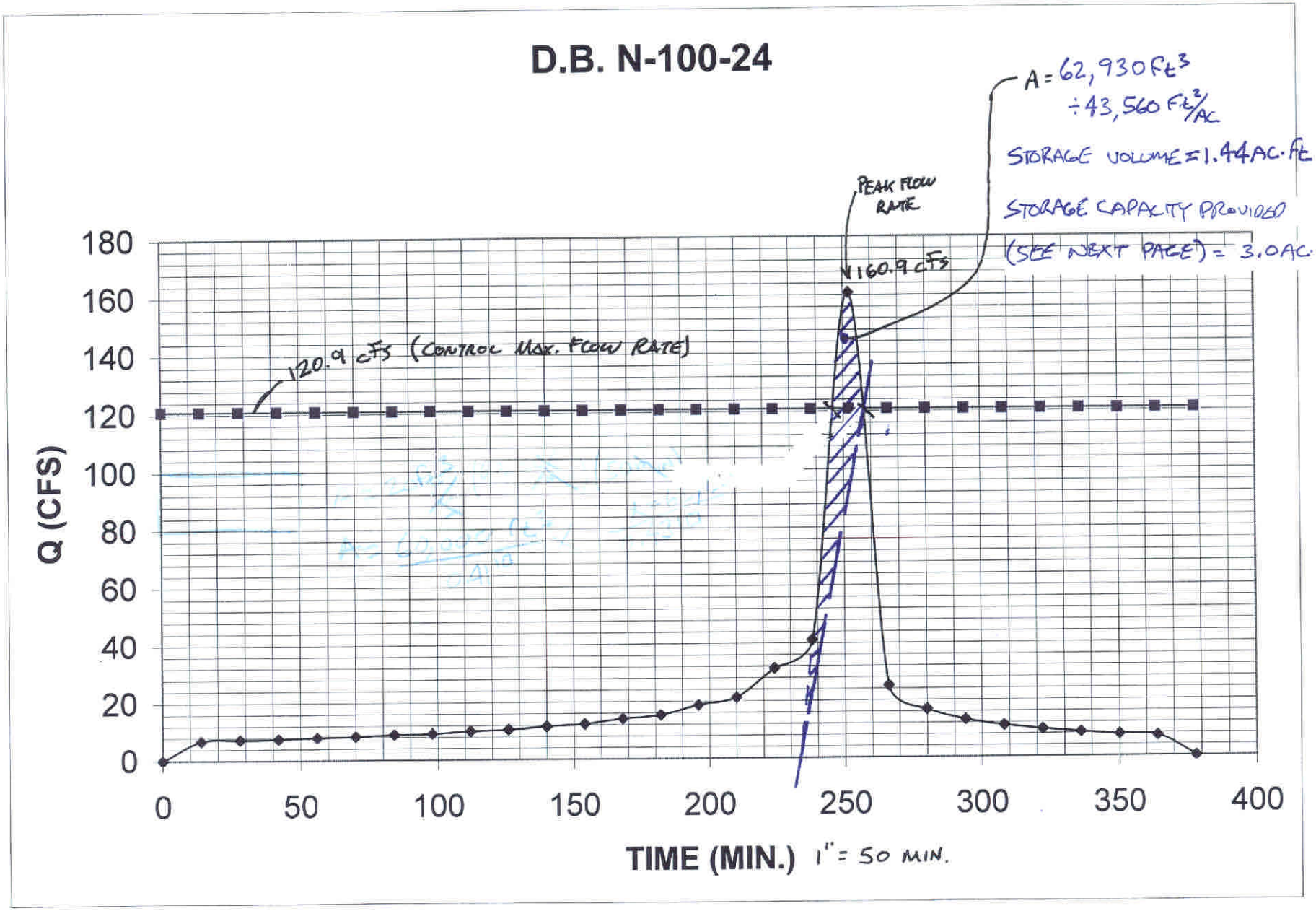

PUMP STATION
ION BASIN
STORAGE
CAPACITY = 5.16 AC-FT
SCHEMATIC
DETENTION
BASIN
DB-N-100-13
78
1526.5
24,777 SF
79
1521.5
47,782 SF
210
1523.5
33,073 SF
211
240'±
300'±
60'
132'±
206'±
180'±
77'±
1510
1520
1500
ACCESS
ROAD
SD
SFM
2:1
R=300'

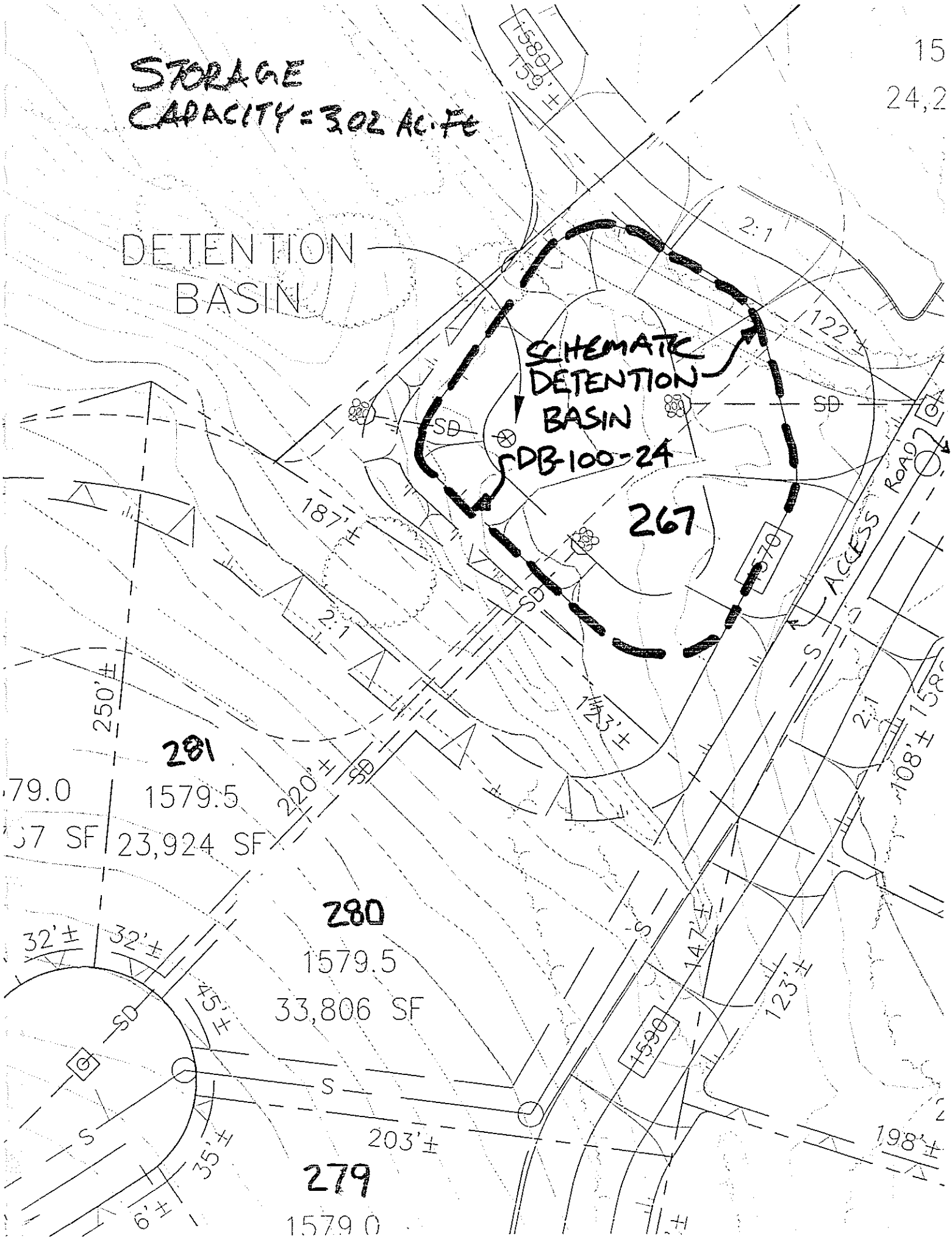
RATIONAL METHOD HYDROGRAPH PROGRAM

DETENTION BASIN N-100-13

RUN DATE 6/17/2004
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 15 MIN.
6 HOUR RAINFALL 3.3 INCHES
BASIN AREA 45.78 ACRES
RUNOFF COEFFICIENT 0.45
PEAK DISCHARGE 91.2 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 15	DISCHARGE (CFS) = 4.1
TIME (MIN) = 30	DISCHARGE (CFS) = 4.2
TIME (MIN) = 45	DISCHARGE (CFS) = 4.5
TIME (MIN) = 60	DISCHARGE (CFS) = 4.6
TIME (MIN) = 75	DISCHARGE (CFS) = 4.9
TIME (MIN) = 90	DISCHARGE (CFS) = 5.1
TIME (MIN) = 105	DISCHARGE (CFS) = 5.6
TIME (MIN) = 120	DISCHARGE (CFS) = 5.8
TIME (MIN) = 135	DISCHARGE (CFS) = 6.5
TIME (MIN) = 150	DISCHARGE (CFS) = 6.9
TIME (MIN) = 165	DISCHARGE (CFS) = 7.9
TIME (MIN) = 180	DISCHARGE (CFS) = 8.5
TIME (MIN) = 195	DISCHARGE (CFS) = 10.4
TIME (MIN) = 210	DISCHARGE (CFS) = 11.9
TIME (MIN) = 225	DISCHARGE (CFS) = 17.5
TIME (MIN) = 240	DISCHARGE (CFS) = 21.6
TIME (MIN) = 255	DISCHARGE (CFS) = 91.2
TIME (MIN) = 270	DISCHARGE (CFS) = 14
TIME (MIN) = 285	DISCHARGE (CFS) = 9.4
TIME (MIN) = 300	DISCHARGE (CFS) = 7.3
TIME (MIN) = 315	DISCHARGE (CFS) = 6.1
TIME (MIN) = 330	DISCHARGE (CFS) = 5.3
TIME (MIN) = 345	DISCHARGE (CFS) = 4.8
TIME (MIN) = 360	DISCHARGE (CFS) = 4.3
TIME (MIN) = 375	DISCHARGE (CFS) = 0


D.B. N-100-24
A = 62,930 Ft³
÷ 43,560 Ft²/AC
STORAGE VOLUME = 1.44 AC. Ft
STORAGE CAPACITY PROVIDED
(SEE NEXT PAGE) = 3.0 AC. Ft
PEAK FLOW RATE
160.9 CFS
120.9 CFS (CONTROL MAX. FLOW RATE)
Q (CFS)
180
160
140
120
100
80
60
40
20
0
0
50
100
150
200
250
300
350
400
TIME (MIN.) 1" = 50 MIN.


STORAGE
CAPACITY = 3.02 Ac.-Ft
DETENTION
BASIN
SCHEMATIC
DETENTION
BASIN
DB-100-24
267
281
280
279
1579.5
33,806 SF
1579.5
23,924 SF
1579.0
ACCESS ROAD
2:1
SD
S
187'±
250'±
220'±
123'±
147'±
203'±
198'±
108'±
32'±
45'±
35'±
6'±
570
580
590

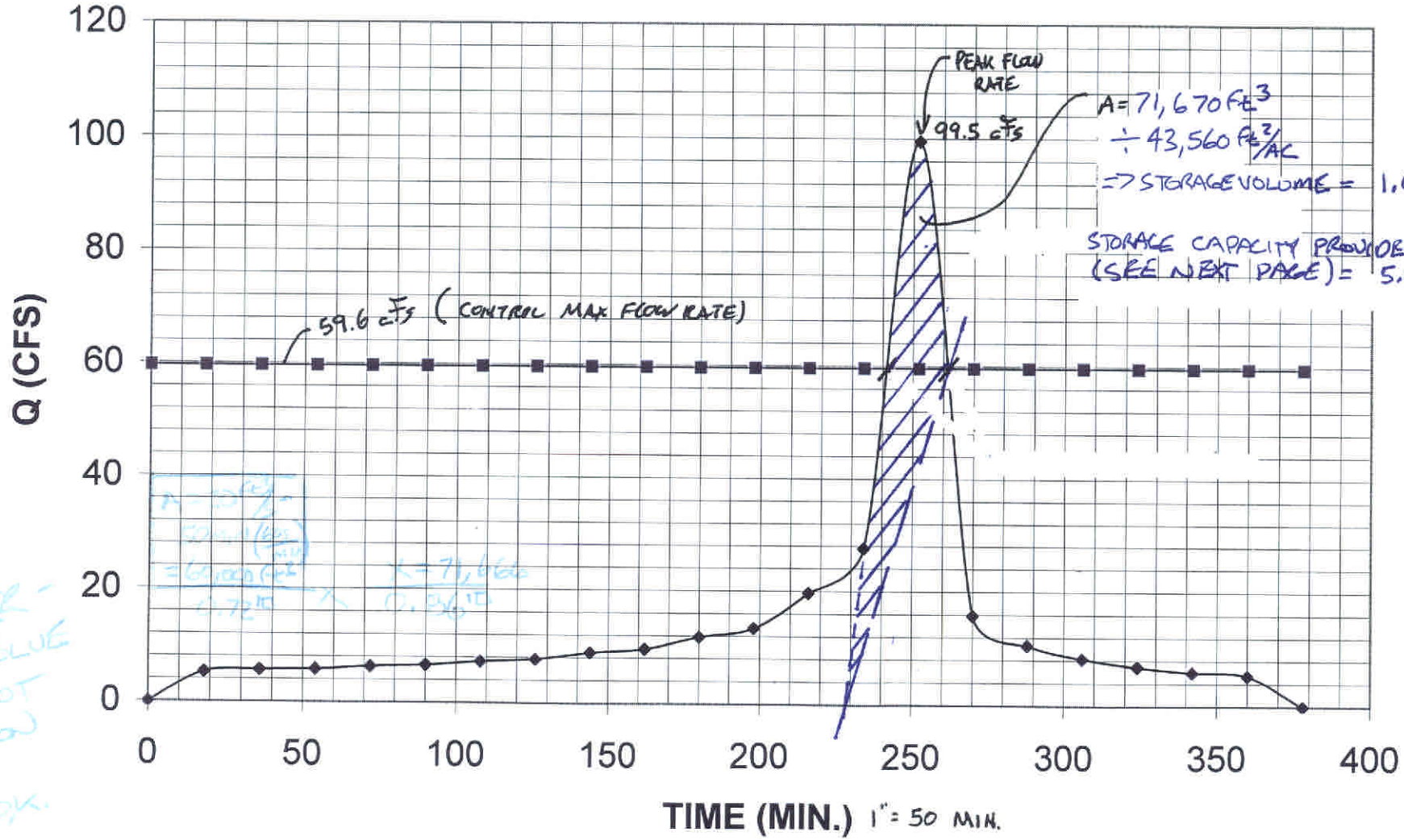
RATIONAL METHOD HYDROGRAPH PROGRAM

DETENTION BASIN N·100·24

RUN DATE 6/17/2004
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 14 MIN.
6 HOUR RAINFALL 3.3 INCHES
BASIN AREA 84.01 ACRES
RUNOFF COEFFICIENT 0.42
PEAK DISCHARGE 160.9 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 14	DISCHARGE (CFS) = 6.9
TIME (MIN) = 28	DISCHARGE (CFS) = 7.3
TIME (MIN) = 42	DISCHARGE (CFS) = 7.5
TIME (MIN) = 56	DISCHARGE (CFS) = 8
TIME (MIN) = 70	DISCHARGE (CFS) = 8.3
TIME (MIN) = 84	DISCHARGE (CFS) = 8.9
TIME (MIN) = 98	DISCHARGE (CFS) = 9.2
TIME (MIN) = 112	DISCHARGE (CFS) = 10
TIME (MIN) = 126	DISCHARGE (CFS) = 10.5
TIME (MIN) = 140	DISCHARGE (CFS) = 11.6
TIME (MIN) = 154	DISCHARGE (CFS) = 12.3
TIME (MIN) = 168	DISCHARGE (CFS) = 14.1
TIME (MIN) = 182	DISCHARGE (CFS) = 15.3
TIME (MIN) = 196	DISCHARGE (CFS) = 18.7
TIME (MIN) = 210	DISCHARGE (CFS) = 21.3
TIME (MIN) = 224	DISCHARGE (CFS) = 31.3
TIME (MIN) = 238	DISCHARGE (CFS) = 41.1
TIME (MIN) = 252	DISCHARGE (CFS) = 160.9
TIME (MIN) = 266	DISCHARGE (CFS) = 25.1
TIME (MIN) = 280	DISCHARGE (CFS) = 16.8
TIME (MIN) = 294	DISCHARGE (CFS) = 13.1
TIME (MIN) = 308	DISCHARGE (CFS) = 11
TIME (MIN) = 322	DISCHARGE (CFS) = 9.6
TIME (MIN) = 336	DISCHARGE (CFS) = 8.5
TIME (MIN) = 350	DISCHARGE (CFS) = 7.7
TIME (MIN) = 364	DISCHARGE (CFS) = 7.1
TIME (MIN) = 378	DISCHARGE (CFS) = 0

D.B. N100-38



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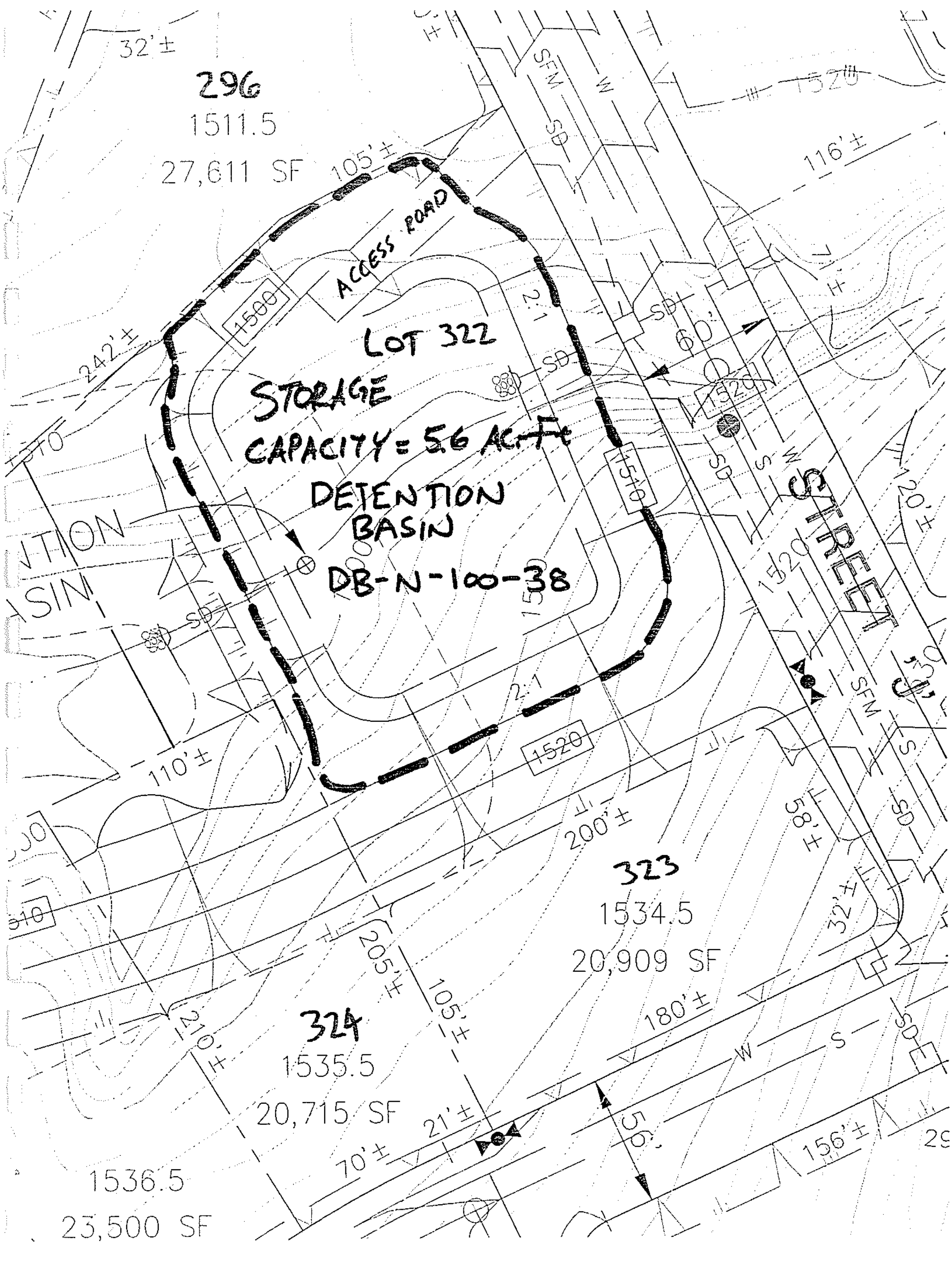

296
1511.5
27,611 SF
32'±
105'±
116'±
1520
ACCESS ROAD
1500
LOT 322
STORAGE
CAPACITY = 5.6 Ac-Ft
DETENTION
BASIN
DB-N-100-38
242'±
2:1
SD
SFM
W
S
60'
1520
1510
STREET
120'±
71'±
30'
J
110'±
1520
200'±
58'±
323
1534.5
20,909 SF
32'±
205'±
210'±
105'±
324
1535.5
20,715 SF
180'±
21'±
70'±
56'
156'±
1536.5
23,500 SF

RATIONAL METHOD HYDROGRAPH PROGRAM
COPYRIGHT 1992, 2001 RICK ENGINEERING COMPANY

DETENTION BASIN N·100·38

RUN DATE 6/17/2004
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 18 MIN.
6 HOUR RAINFALL 3.3 INCHES
BASIN AREA 59.34 ACRES
RUNOFF COEFFICIENT 0.44
PEAK DISCHARGE 99.5 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 18	DISCHARGE (CFS) = 5.2
TIME (MIN) = 36	DISCHARGE (CFS) = 5.6
TIME (MIN) = 54	DISCHARGE (CFS) = 5.8
TIME (MIN) = 72	DISCHARGE (CFS) = 6.3
TIME (MIN) = 90	DISCHARGE (CFS) = 6.6
TIME (MIN) = 108	DISCHARGE (CFS) = 7.3
TIME (MIN) = 126	DISCHARGE (CFS) = 7.7
TIME (MIN) = 144	DISCHARGE (CFS) = 8.9
TIME (MIN) = 162	DISCHARGE (CFS) = 9.6
TIME (MIN) = 180	DISCHARGE (CFS) = 11.8
TIME (MIN) = 198	DISCHARGE (CFS) = 13.4
TIME (MIN) = 216	DISCHARGE (CFS) = 19.7
TIME (MIN) = 234	DISCHARGE (CFS) = 27.6
TIME (MIN) = 252	DISCHARGE (CFS) = 99.5
TIME (MIN) = 270	DISCHARGE (CFS) = 15.8
TIME (MIN) = 288	DISCHARGE (CFS) = 10.6
TIME (MIN) = 306	DISCHARGE (CFS) = 8.3
TIME (MIN) = 324	DISCHARGE (CFS) = 6.9
TIME (MIN) = 342	DISCHARGE (CFS) = 6
TIME (MIN) = 360	DISCHARGE (CFS) = 5.4
TIME (MIN) = 378	DISCHARGE (CFS) = 0

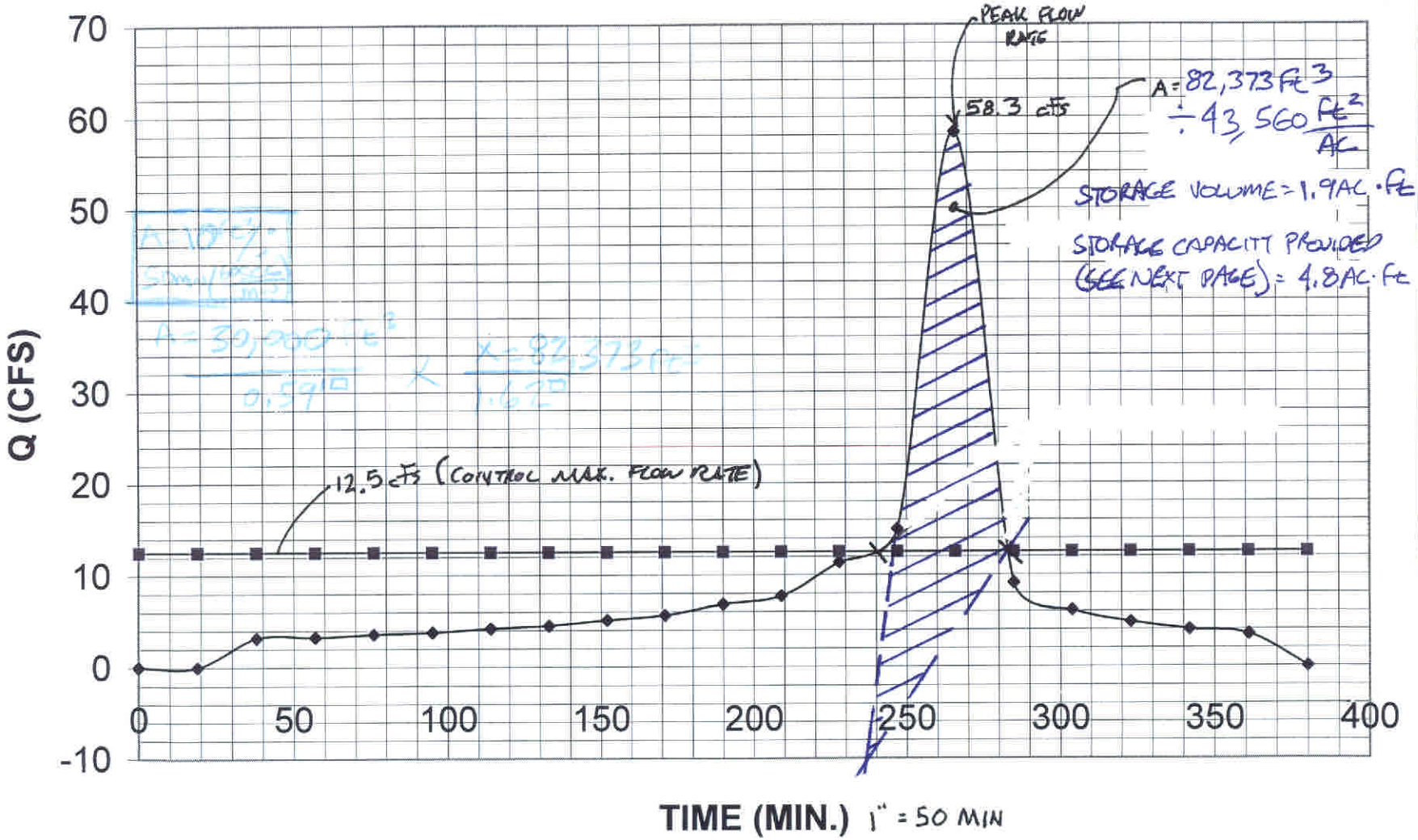
SECTION 6.2

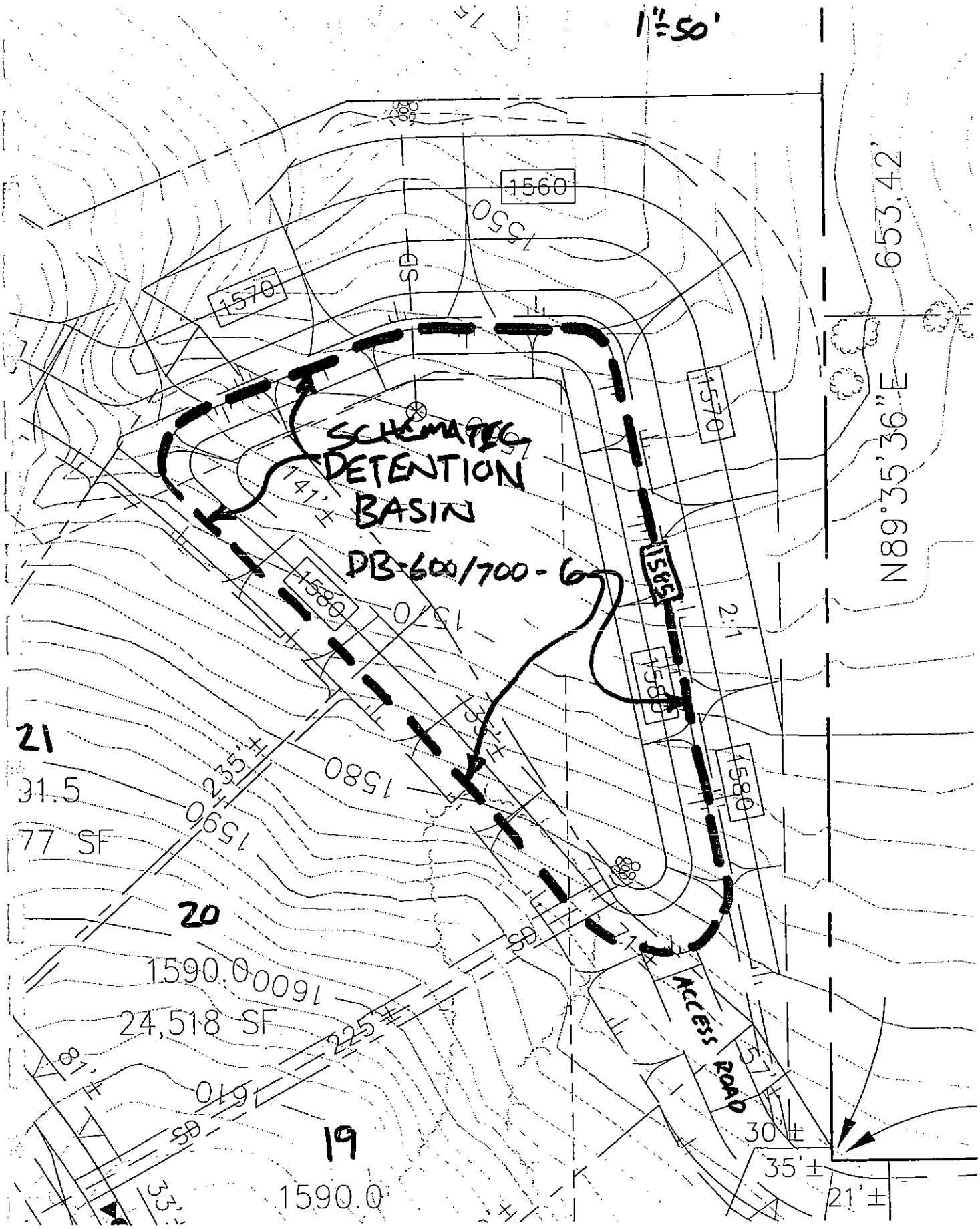
Basin N600/700

Proposed flow rate for Basin N-600/700 at Node 600/700 is approximately 12 cfs higher than the existing flow rate during the 100-year storm event. The same method that was utilized for Basin N-100 above will be applied for Basin N600/700.

The release rate from detention Basins DB N600/700-6, in proposed Basin N-600/700, has been reduced by 12 cfs. The difference in the peak flow rate and control flow rate for the detention basin over the given time interval, (See flowing graphs in this section), is the minimum storage volume necessary to control the peak flow rate at Node 601/701 (see Section 5 "Developed On-site Drainage Basins" exhibit for detention basin location and designations).

D.B. N600/700-6


PEAK FLOW RATE
58.3 cfs
A = 82,373 ft³ ÷ 43,560 ft²/AC
STORAGE VOLUME = 1.9AC.·ft
STORAGE CAPACITY PROVIDED (SEE NEXT PAGE) = 4.8AC·ft
12.5 cfs (CONTROL MAX. FLOW RATE)
Q (CFS)
70
60
50
40
30
20
10
0
-10
0
50
100
150
200
250
300
350
400
TIME (MIN.) 1" = 50 MIN


STORAGE CAPACITY = 4.8 AC-Ft
1"=50'
1560
1570
1580
1590
SD
SCHEMATIC
DETENTION
BASIN
DB-600/700-6
141'±
653.42'
N89°35'36"E
2:1
21
31.5
77 SF
20
1590.0
24,518 SF
19
1590.0
ACCESS ROAD
30'±
35'±
21'±

DETENTION BASIN DB-600/700-6

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 6/17/2004
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 19 MIN.
6 HOUR RAINFALL 3.3 INCHES
BASIN AREA 34.66 ACRES
RUNOFF COEFFICIENT 0.45
PEAK DISCHARGE 58.3 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 19	DISCHARGE (CFS) = 0
TIME (MIN) = 38	DISCHARGE (CFS) = 3.2
TIME (MIN) = 57	DISCHARGE (CFS) = 3.3
TIME (MIN) = 76	DISCHARGE (CFS) = 3.6
TIME (MIN) = 95	DISCHARGE (CFS) = 3.8
TIME (MIN) = 114	DISCHARGE (CFS) = 4.2
TIME (MIN) = 133	DISCHARGE (CFS) = 4.5
TIME (MIN) = 152	DISCHARGE (CFS) = 5.1
TIME (MIN) = 171	DISCHARGE (CFS) = 5.6
TIME (MIN) = 190	DISCHARGE (CFS) = 6.8
TIME (MIN) = 209	DISCHARGE (CFS) = 7.7
TIME (MIN) = 228	DISCHARGE (CFS) = 11.4
TIME (MIN) = 247	DISCHARGE (CFS) = 15
TIME (MIN) = 266	DISCHARGE (CFS) = 58.3
TIME (MIN) = 285	DISCHARGE (CFS) = 9.1
TIME (MIN) = 304	DISCHARGE (CFS) = 6.1
TIME (MIN) = 323	DISCHARGE (CFS) = 4.8
TIME (MIN) = 342	DISCHARGE (CFS) = 4
TIME (MIN) = 361	DISCHARGE (CFS) = 3.5
TIME (MIN) = 380	DISCHARGE (CFS) = 0

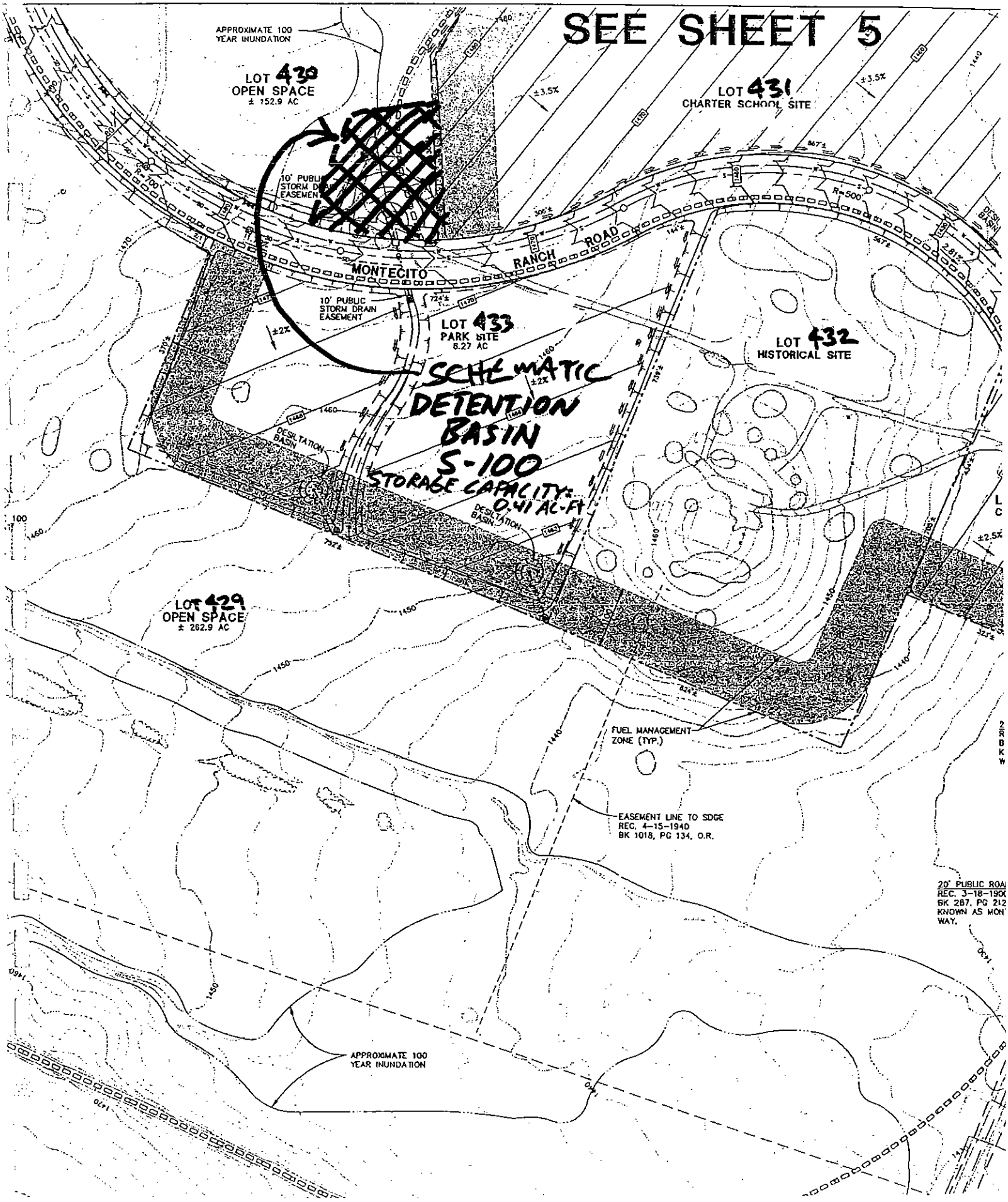
SECTION 6.3

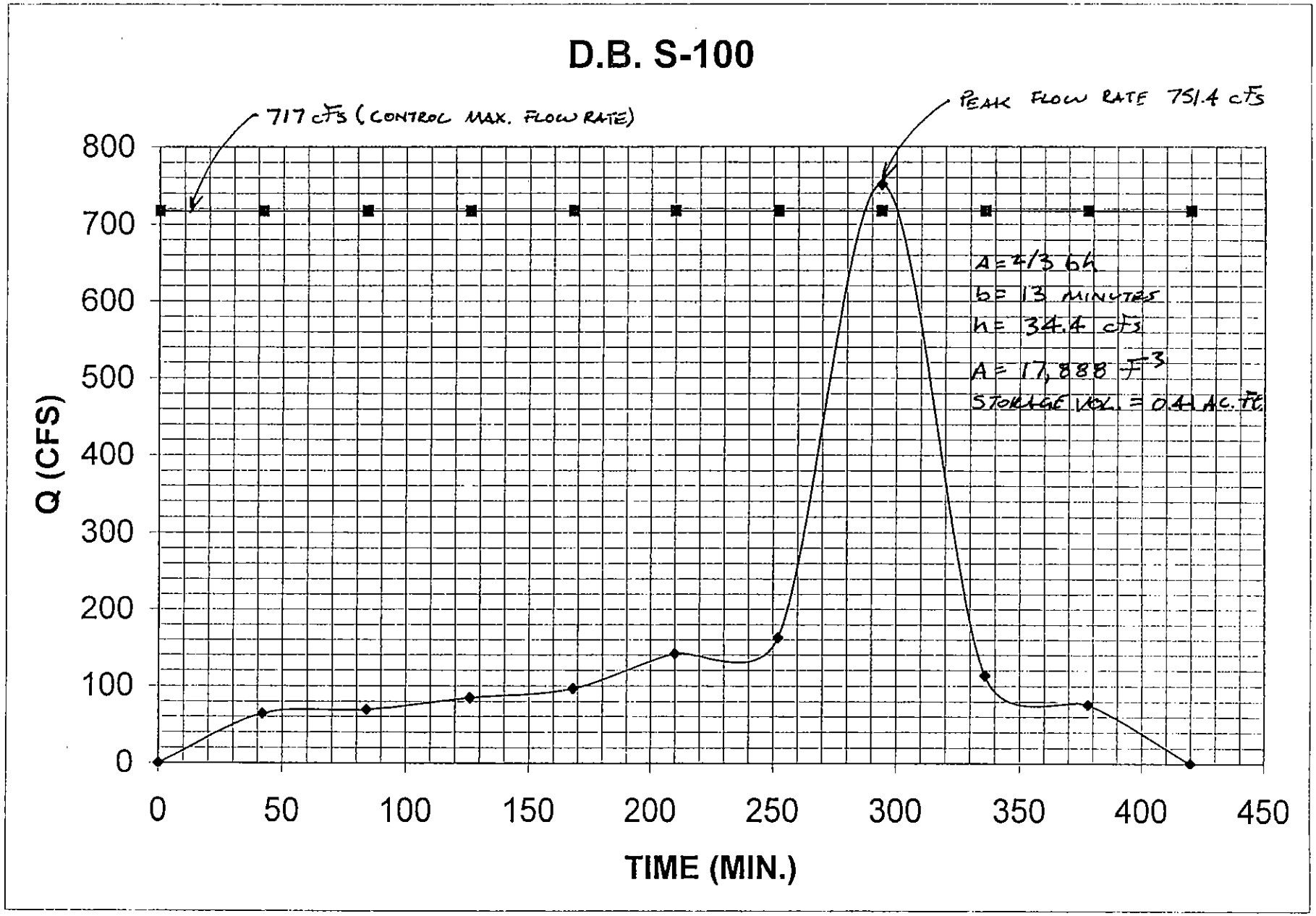
Basin S100

Detention within Basin S100 will take place north of the charter school site within lot 430. No specific detention basins are detailed at this time. Resultantly, final detention basin routing will occur at final engineering, this study provides preliminary calculations for required detention based upon County criteria (see "CRITERIA" at the beginning of Section 6). This section provides preliminary detention basin routing for estimating storage volume only.

Proposed flow rate for Basin S100 at Node 001 is approximately 41 cfs higher than the existing flow rate during the 100-year storm event. The same method that was utilized for Basin N100 above will be applied for Basin S100.

The release rate from detention basins DB S100, in proposed Basin S100, has been reduced by 41 cfs. The difference in the peak flow rate and control flow rate for the detention basin over the given time interval, (See flowing graphs in this section), is the minimum storage volume necessary to control the peak flow rate at Node 001 (see Section 5 "Developed On-site Drainage Basins" exhibit for detention basin location and designations).


SEE SHEET 5
APPROXIMATE 100 YEAR INUNDATION
LOT 430
OPEN SPACE
± 152.9 AC
LOT 431
CHARTER SCHOOL SITE
10' PUBLIC STORM DRAIN EASEMENT
MONTECITO
RANCH
ROAD
10' PUBLIC STORM DRAIN EASEMENT
LOT 433
PARK SITE
6.27 AC
LOT 432
HISTORICAL SITE
SCHEMATIC
DETENTION
BASIN
S-100
STORAGE CAPACITY:
0.41 AC-FT
DESILTATION BASIN
DESILTATION BASIN
LOT 429
OPEN SPACE
± 262.9 AC
FUEL MANAGEMENT ZONE (TYP.)
EASEMENT LINE TO SDGE
REC. 4-15-1940
BK 1018, PG 134, O.R.
APPROXIMATE 100 YEAR INUNDATION


D.B. S-100
717 cfs (CONTROL MAX. FLOW RATE)
PEAK FLOW RATE 751.4 cfs
A=4/3 bh
b= 13 MINUTES
h= 34.4 cfs
A= 17,888 ft^3
STORAGE VOL. = 0.41 AC. FT.
Q (CFS)
800
700
600
500
400
300
200
100
0
0
50
100
150
200
250
300
350
400
450
TIME (MIN.)

RATIONAL METHOD HYDROGRAPH PROGRAM

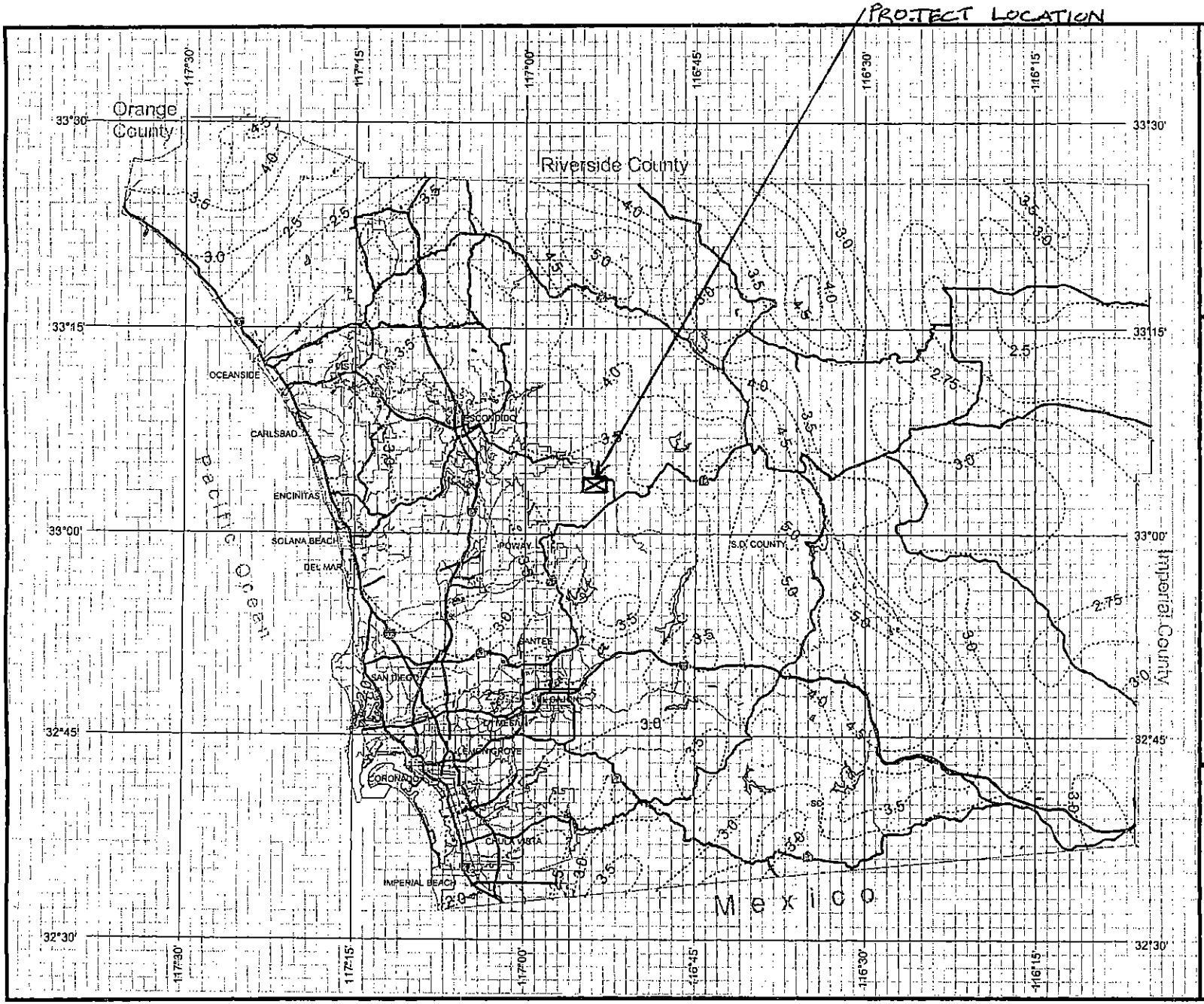
RUN DATE 6/29/2004
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 42 MIN.
6 HOUR RAINFALL 3.3 INCHES
BASIN AREA 926.9 ACRES
RUNOFF COEFFICIENT 0.35
PEAK DISCHARGE 751.4 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 42	DISCHARGE (CFS) = 63.9
TIME (MIN) = 84	DISCHARGE (CFS) = 69.2
TIME (MIN) = 126	DISCHARGE (CFS) = 84.6
TIME (MIN) = 168	DISCHARGE (CFS) = 96.4
TIME (MIN) = 210	DISCHARGE (CFS) = 141.5
TIME (MIN) = 252	DISCHARGE (CFS) = 162.8
TIME (MIN) = 294	DISCHARGE (CFS) = 751.4
TIME (MIN) = 336	DISCHARGE (CFS) = 113.5
TIME (MIN) = 378	DISCHARGE (CFS) = 76
TIME (MIN) = 420	DISCHARGE (CFS) = 0

7

SECTION 7

APPENDIX- COUNTY DESIGN CHARTS & NOMOGRAPHS



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

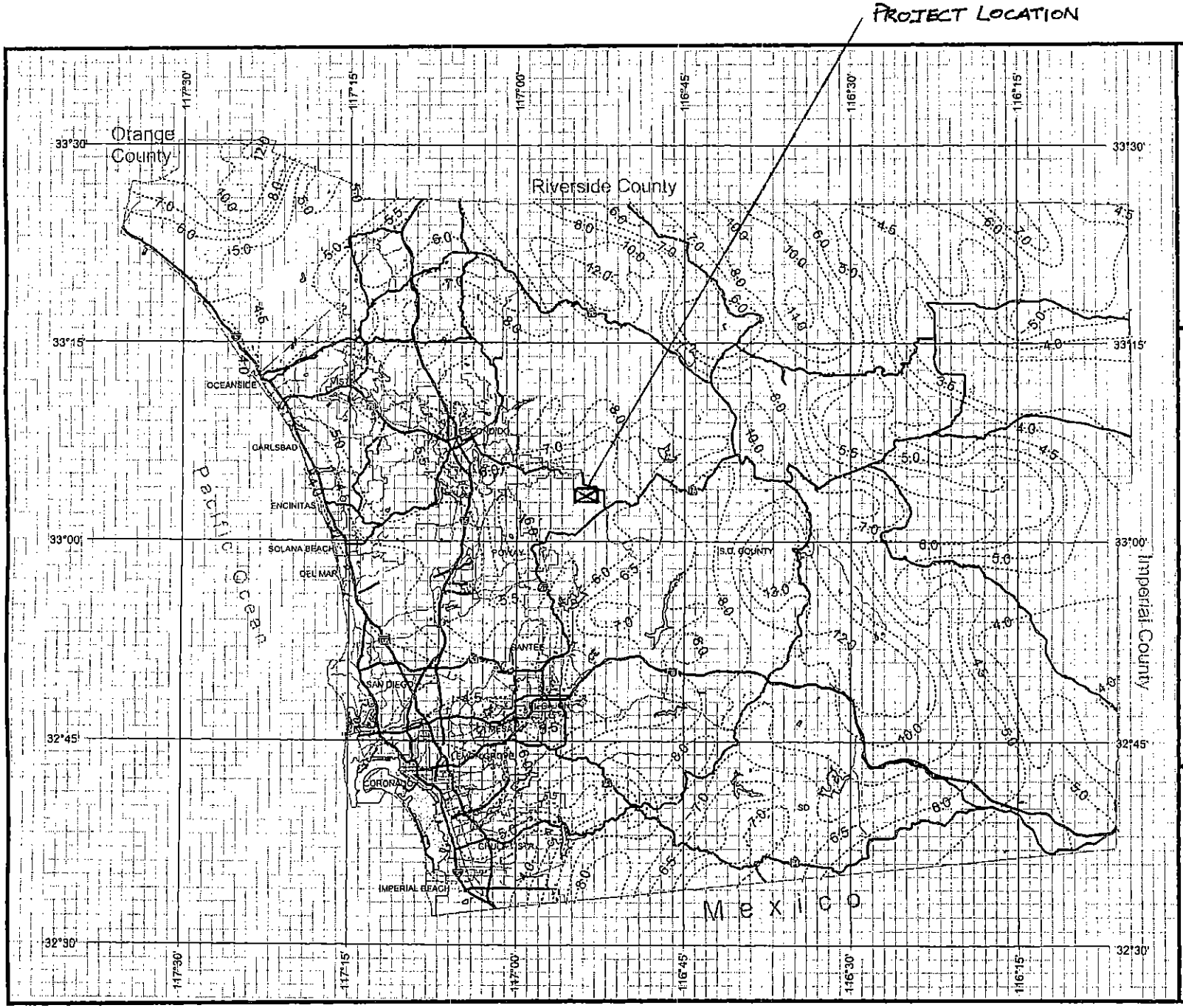
$P_{6(100)} = 3.3$

DPW GIS

GIS

N W E S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

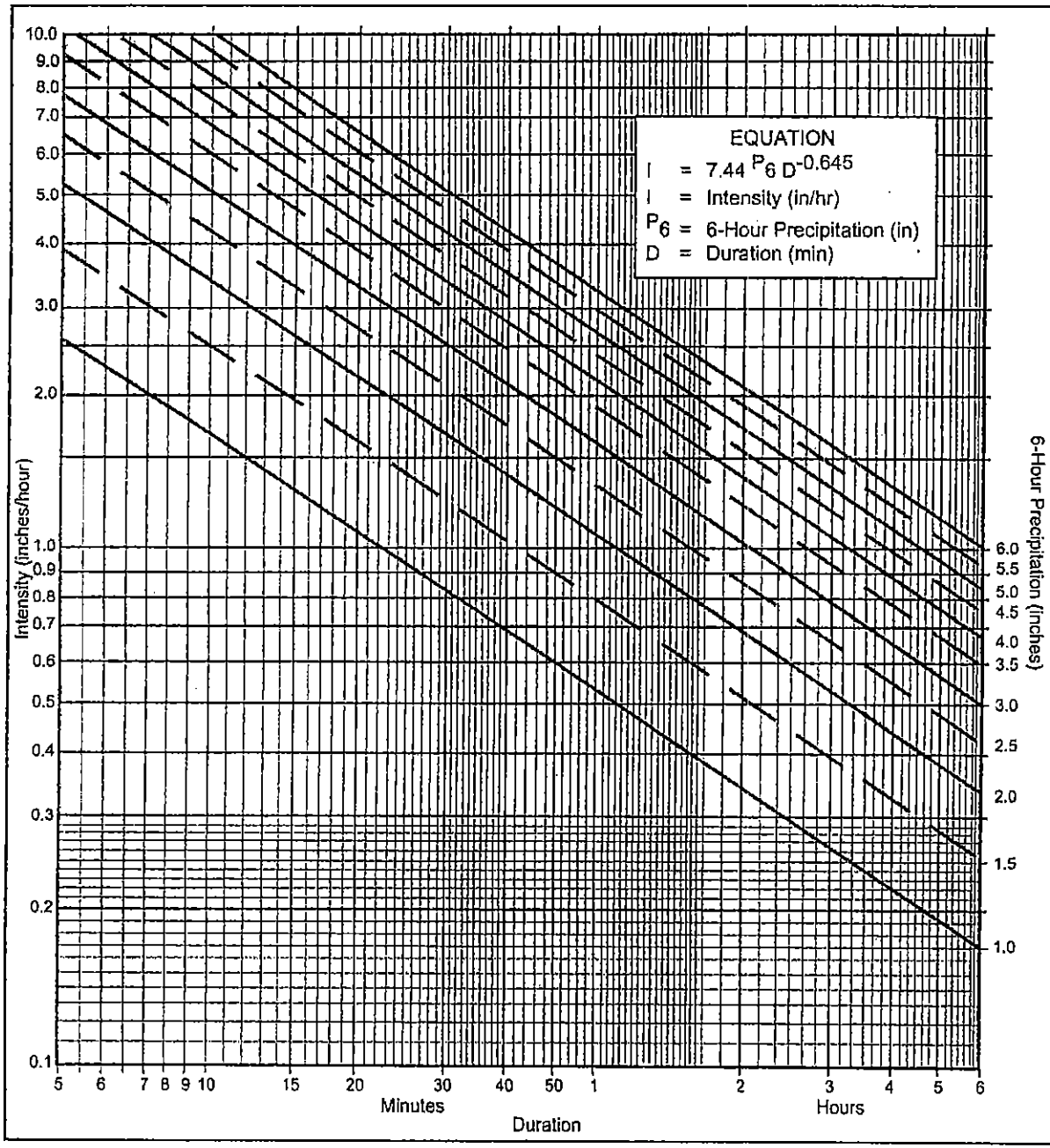
$P_{24\,(100)} = 5.7$

DPW GIS

SanGIS

N W E S

3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 3.3 in., P_{24} = 5.7, $\frac{P_6}{P_{24}}$ = 0.58 %(2)

(c) Adjusted P_6(2) = 3.3 in.

(d) t_x = ~~/~~ min.

(e) I = ~~/~~ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.66	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

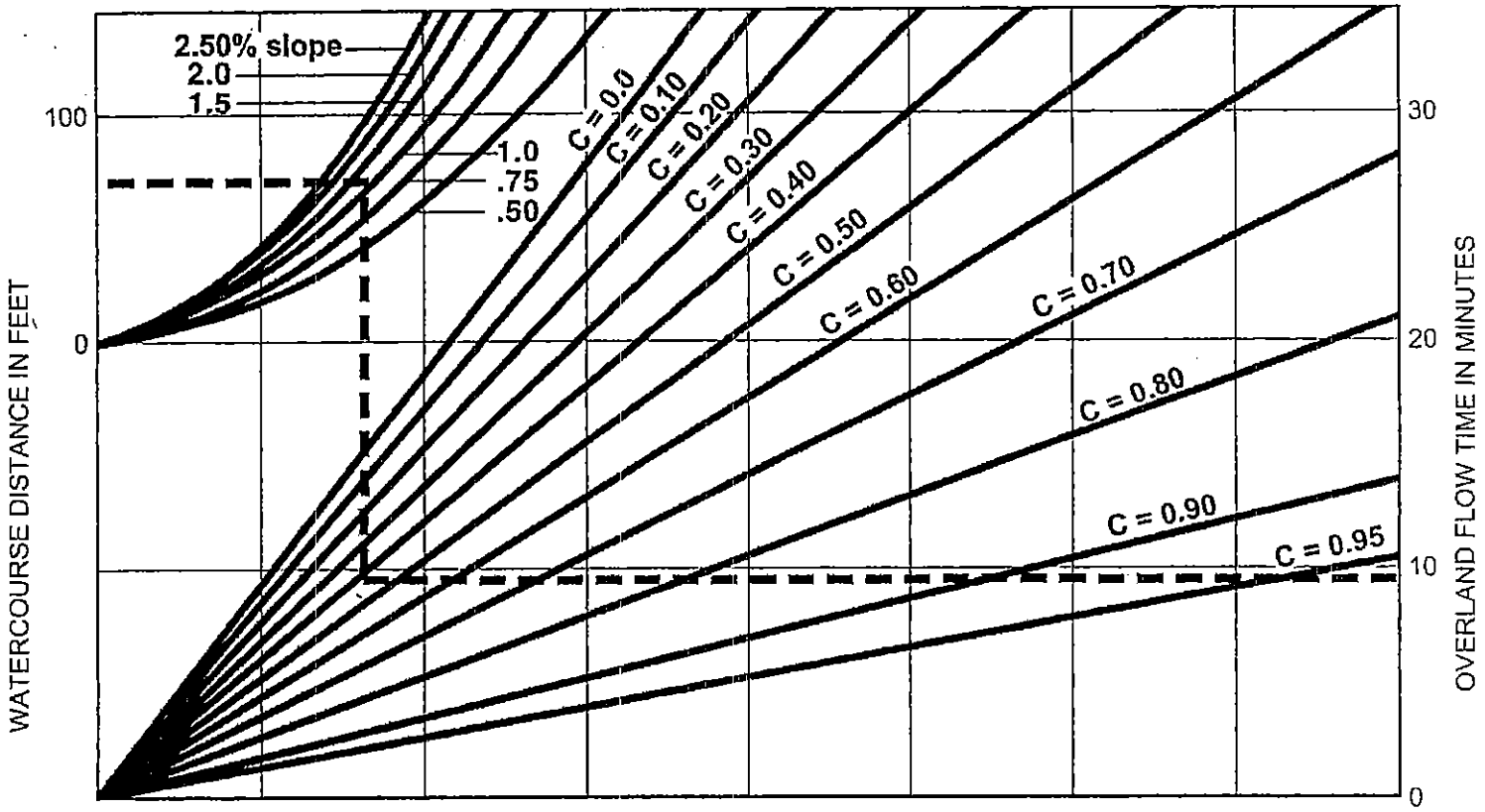
Intensity-Duration Design Chart - Template

FIGURE
3-1

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

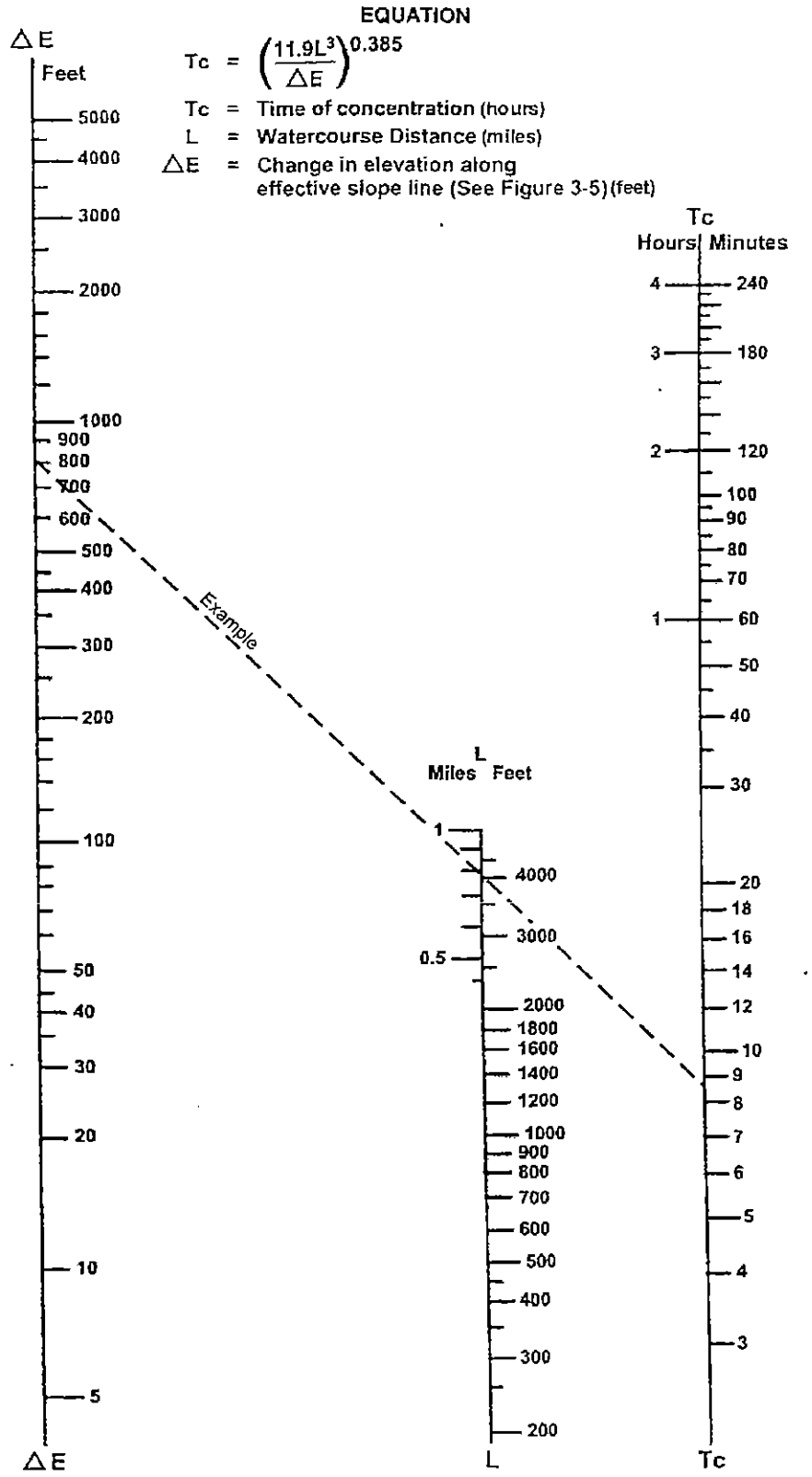
$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

3-3

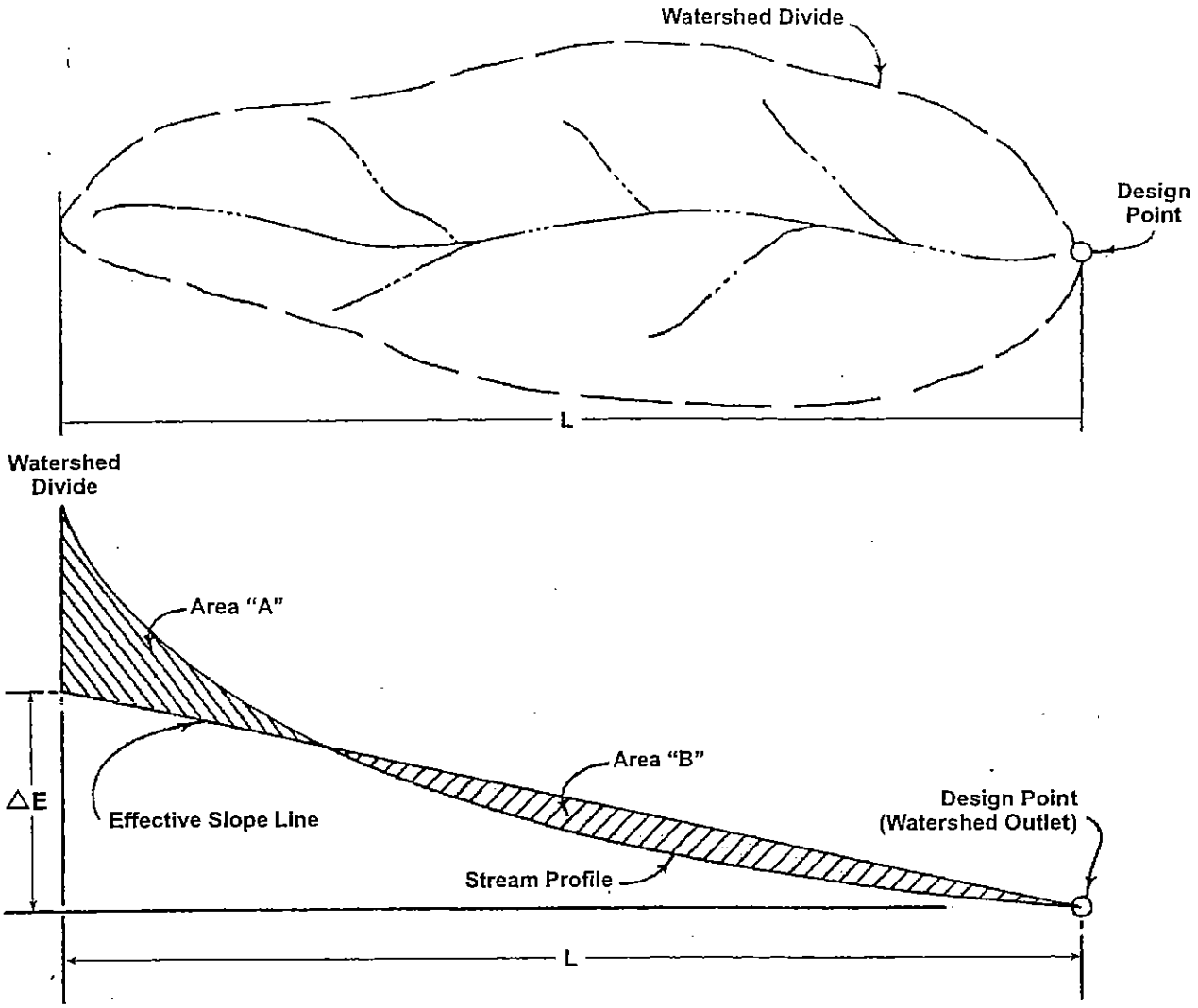
Rational Formula - Overland Time of Flow Nomograph



SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds



SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-5

Computation of Effective Slope for Natural Watersheds